ARMED FORCES CHEMICAL JOURNAL

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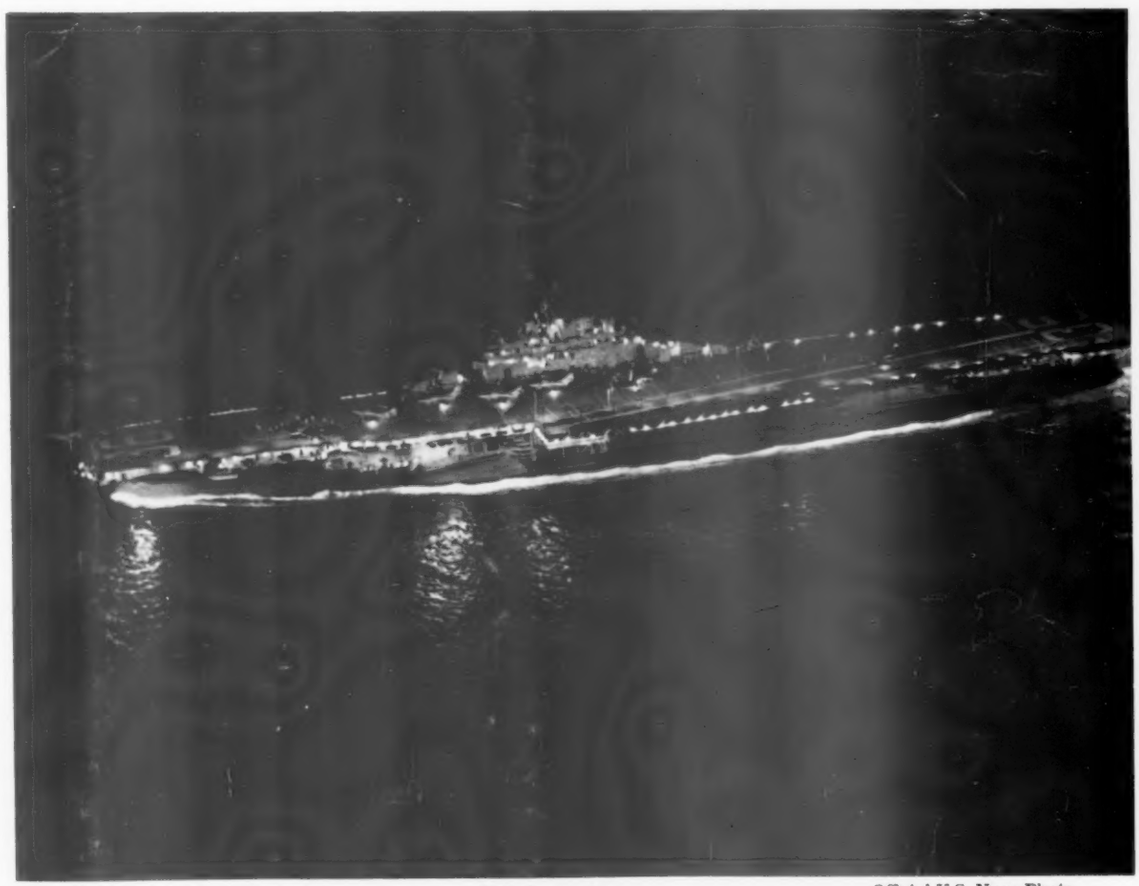
Complete Program for the 11th Annual Meeting of A.F.C.A. in Boston, June 14-15



U.S.S. Antietam — Official U.S. Navy Photo

MARCH-APRIL 1956

FAMOUS LIGHTHOUSES OF AMERICA

BARNEGAT LIGHT is located on Island Beach at the south side of the entrance to Barnegat Inlet, New Jersey. For more than a century its beacon has been a familiar course-marker to all craft traveling the steamer lanes off the Jersey coast. The first lighthouse, built in 1835, was leveled by a pounding Atlantic. The present tower, 161 feet high and made of brick, was completed in 1858, 900 feet south of the original structure. The tower itself is now owned by the State of New Jersey but the light is maintained by the U. S. Coast Guard.

ARMED FORCES CHEMICAL JOURNAL

OFFICIAL PUBLICATION OF THE ARMED FORCES CHEMICAL ASSOCIATION

SUITE 819, 2025 EYE STREET, N.W., WASHINGTON 6, D.C.

VOLUME X MARCH-APRIL 1956 NO. 2

COVER PHOTO

Night view of the U.S.S. ANTIETAM in full illumination. For information concerning the vessel and its part in A.F.C.A.'s meeting in Boston this June see pages 5 and 7.

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ADVERTISERS

Published bi-monthly—Jan.-Feb.; Mar.-Apr.; May-June; Jul.-Aug.; Sept.-Oct.; Nov.-Dec.—by the Armed Forces Chemical Association, located at National Headquarters, Armed Forces Chemical Association, Suite 819, 2025 Eye St., N. W., Washington 6, D. C. Entered as second class matter at the Post Office at Washington, D. C., under the Act of March 3, 1879. Additional entry at Nashville, Tenn. Subscription price $2.00 per year to members; $4.00 per year to non-members. Inquiries concerning circulation and advertising should be addressed to the Secretary-Treasurer.

—Official U.S. Navy Photograph

ADMIRAL ARLEIGH A. BURKE
CHIEF OF NAVAL OPERATIONS

THE DISTINGUISHED record of Admiral Arleigh A. Burke, new Chief of Naval Operations, whose appointment was confirmed August 17, 1955, has been widely told and needs no retelling here. It would require pages to present the citations of his awards which include the Distinguished Service Medal with Gold Star, the Navy Cross, and the Silver Star Medal. Presentation in this issue of the full program for A.F.C.A.'s next annual meeting, when the Navy is to be the host service, provides a fitting occasion for printing Admiral Burke's picture. For A.F.C.A. it is especially interesting to learn that Admiral Burke did graduate work in chemistry at the University of Michigan and holds the degree of M.S. in engineering from that institution. He is a member of the American Chemical Society, American Institute of Chemical Engineers, and Iota Alpha, honorary fraternity for chemical engineers.

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U. S. S. ANTIETAM COMMANDER AND STAFF

Official U. S. Navy Photographs

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A. F. C. A.'s HOSTS ON JUNE 15

2

3

5

6

7

8

1
CAPT. FRANCIS E. BARDWELL
Commanding Officer

2
CDR. ARTHUR M. ERSHLER
Executive Officer

3
U.S.S. Antietam

4
CDR. J. M. ARBUCKLE
Operations Officer

5
CDR. WALTER F. MCGUIRE
Navigator

6
CDR. LEONARD J. REINTJES
Air Officer

7
CDR. RICHARD P. JEFFREY
Supply Officer

8
LT. CDR. ALBERT J. POPE
Asst. Air Officer & Public Information Officer

SPEAKERS' LIST NOW ARRANGED A. F. C. A. MEETING—JUNE 14-15

MEN OF OUTSTANDING achievement and reputation in science, industry, or education, all actively concerned with technological problems confronting the government today, are on A.F.C.A.'s program for the eleventh annual meeting of the Association to be held in Boston and vicinity on June 14 and 15.

This phase of the two-day session matches in importance and interest the series of events, unusual for civilian visitors, scheduled by the Navy as the host service for the Association's gathering this year. These events include a day at sea aboard the aircraft carrier, *USS Antietam*, during antisubmarine training operations.

Not only have invitations for the speakers' list already been extended but firm acceptances have now been received by Chairman Harry A. Wansker of the New England Chapter's General Committee on Arrangements for the meeting. Mr. Wansker is also vice president (Meetings) of the National Association.

Dr. Furnas for the Banquet

For the annual banquet to be held at the Hotel Somerset, Boston, on the night of June 15, the guest speaker will be The Hon. Clifford C. Furnas, Assistant Secretary of Defense (Research & Development), chemical scientist and engineer, long associated with aeronautics and guided missiles research. Dr. Furnas is currently on leave of absence as Chancellor of the University of Buffalo. The title of his address has not yet been announced but it is assumed that it will deal in broad brush at least with one or more phases of the defense research program.

At the general session of the Association at the Hotel Somerset on the morning of June 14, following the closed meeting of the Board of Directors, there will be a talk by Dr. Per K. Frolich, Chief Scientist of the Chemical Corps. His subject is entitled, "The New Mission and the Reorganization of the Chemical Corps." Dr. Frolich, formerly a vice president of Merck & Co., is one of the Directors-at-Large of A.F.C.A. The Chemical Corps has recently been undergoing some organizational changes following a study on the subject by an ad hoc committee headed by Mr. Otto N. Miller, vice president of the Standard Oil Company of California, which was appointed by Maj. Gen. W. M. Creasy, Chief Chemical Officer.

Preceding the general session the Board of Directors will hold their annual meeting in the Princess Room of the Hotel. Especial interest attaches to that meeting since it will include the election of officers for the forthcoming year, including a new president since Admiral Prime will have completed two terms in that office. The election results will be announced at the general session.

Afternoon Session to be at M.I.T.

On the afternoon of June 14 a program of addresses will be held at the Kresge Auditorium of the Massachusetts Institute of Technology, in Cambridge, where Dr. James R. Killian, Jr., the president, will welcome the A.F.C.A. members and their guests to the Institute. Mr. Albert E. Forster, president of the Hercules Powder Company of Wilmington, Del., will be the presiding officer for the afternoon session.

Dr. John von Neuman, noted mathematician, chemical and atomic scientist, a member of the United States Atomic Commission, will present a paper at this session on "Some Modern Concepts of Scientific Bases of Weapons Systems."

Another presentation at this time which promises to be of much timely interest will be a paper by Dr. Joseph Kaplan, chairman of the United States Committee for the International Geophysical Year. Dr. Kaplan will describe this unprecendented program of cooperative scientific endeavor involving some 40 nations which is to begin during the summer of 1957. It is expected that his presentation will include some discussion of the much publicized project for an artificial satellite to revolve in outer space about the earth. While the IGY is nonmilitary in its purpose and scope, the Arrangements Committee considers that its great scientific importance and the broad interests of A.F.C.A. in science make the IGY a very fitting subject for the meeting.

Also listed for this session is a talk by Captain Francis E. Bardwell, commanding officer of the *USS Antietam*. This will be by way of welcome and advance briefing for

(Continued on page 7)

MEETING CHAIRMAN

—Fay Photo Service, Inc.

Harry A. Wansker, chairman of the New England Chapter's General Committee on Arrangements for the A.F.C.A. annual meeting in Boston on June 14-15, was born November 23, 1893, in New York City. While still an infant his parents moved to Newton, Massachusetts, where Mr. Wansker grew up. After graduation from the Newton High School in 1913, he attended M.I.T., and received a B.S. degree in civil engineering there in 1917. Following a period (1917-21) of service in the Navy he established himself as a consulting management engineer. Since 1943 Mr. Wansker has been with the United-Carr Fastener Corporation, with headquarters in Cambridge, Mass., as Director of Government Relations. He was first elected vice president of A.F.C.A and chairman of the Meetings Committee in 1953.

Mr. Wansker is a member of various national defense organizations in addition to A.F.C.A., and is a member of the University Club of Washington, D. C., and the M.I.T. Faculty Club of Boston. His home is at Newtonville, Mass.

THE HON. CLIFFORD C. FURNAS

Assistant Secretary of Defense (R&D)

Born Sheridan, Ind., 1900; B.S. Purdue, '22; Ph.D., Michigan, '26; Olympic Games, Antwerp, competed in the 5,000 Metres, 1920; athletic coach, math teacher; research chemist, U. S. Steel Corp. 1924-25; physical chemist, Bur. of Mines, 1926-31; assoc. prof., chem. engr. Yale; lecturer, Columbia; with N.D.R.C. during World War II; dir., Cornell Aeronautical Lab., 1946-55; Chancellor, Univ. of Buffalo, 1955 (on leave to Feb. 1, 1957); mem. A.I.C.E., A.C.S., Newcomen Society, Sigma Xi, Tau Beta Pi, Phi Lambda Upsilon and Theta Chi; fellow, American Assoc. for the Advancement of Science and the Inst. of Aeronautical Science. Author, "The Next Hundred Years," Book-of-the-Month selection; editor of the 1942 edition of Roger's Manual of Industrial Chemistry and the 1948 Indus. Research Inst. monograph on Indus. Research—Its Organization and Management, author of about 100 technical papers.

DR. PER K. FROLICH

Chief Scientist, Chemical Corps

Born Kistiansand, Norway, 1899; naturalized 1929; student and teacher, Norway Inst. of Technology; graduate student Mass. Inst. of Tech., followed by appt. as assoc. prof. of chem. engr. there in 1927; Standard Oil Development Co., 1929; World War II, N.D.R.C. and as con., Office of Rubber Reserve; Merck & Co., 1946, became vice pres. for scientific activities; Director-at-Large, A.F.C.A. since 1949; joined Chemical Corps in December 1954; honorary doctoral degrees, Rutgers and Lehigh Universities; past president, American Chemical Society; member, American Institute of Chemical Engineers and various other organizations. Author about 60 tech. papers; holds about 75 pats. issued or pending, chiefly in fd. of hydrocarb. proc.; Grasselli Medal 1930; visiting comm., Dept of Biology, M.I.T., 1949-date; Adv. Council, Dept. of Chem. Engrg., Princeton, 1948-date; Chem. Adv. Comm., Rutgers, 1940-date.

—Willard Stewart, Inc.

MR. ALBERT E. FORSTER

President, Hercules Powder Co., Wilmington, Del.

Born Cuernavaca, Mexico, 1901, where his father, a railroad engineering executive, and mother were residing temporarily; educated, San Francisco schools; B.A. in geology, degree in mining engineering, Stanford Univ.; tech. service man, Hercules, San Francisco, 1925; in Brazil 1930–34 with subsdry. of Amer. and Foreign Power Corp.; returned Hercules Explosive Dept., Wilmington, '34; subsequent appts.; asst. superintendent, Explosives Dept. plant, Carthage, Mo.; asst. mgr., Birmingham, Ala., sales office; mgr., Naval Stores Dept.; Bd. of dir., 1940; v-pres., 1951; pres. and chmn. of exec. comm., April 29, 1953; mem., Amer. Inst. of Mining and Metallurgical Engineers; dir., Mfg. Chemists Assn., mem., Nat'l Comm. on Boys and Girls Clubs, directing 4-H activities; mem., exec. bd., Delmarva Council, Boy Scouts of America; dir., United Community Fund of Northern Delaware.

MEETING SPEAKERS

DR. JOSEPH KAPLAN

Chairman, U. S. National Committee for the I.G.Y.

Born Tapoicza, Hungary, 1902; naturalized 1920; B.S. chem., 1924, M.A., 1926, Ph.D., 1927, Johns Hopkins Univ.; Nat'l. Research fellow in physics, Princeton, 1927-28; worked there under Dr. Karl T. Compton and published several papers on active hydrogen and nitrogen and excitation of the green auroral line which formed the foundation of much of his subsequent work on upper atmospheric spectra; asst. prof. of physics, U.C.L.A., 1928; prof. since 1940; chief, Operations Anal. Sec., Second Air Force (on leave from U.C.L.A.) 1943-45; later with Air Weather Serv.; Ex. Civil. Serv. Award, 1947; Air Force Scientific Advisory Bd. mem.; fel., Amer. Physical Soc.; mem. Amer. Astronomical Soc., Amer. Meteorological Soc. and Inst. of Aeronautical Sciences; mem. Gov. of California's Special Tech. Comm. on Air Pollution; v-pres., International Assoc. of Geomagnetism and Aeronomy and chmn. of that Assn.'s Comm. on the High Atmosphere.

DR. JOHN von NEUMAN

United States Atomic Energy Commissioner

Born Budapest, Hungary, 1903; naturalized 1937; Univ. of Berlin, 21-23; Engr. of Chem., Federal Inst. of Tech., Zurich, Switzerland, 1925; Ph.D., Univ. of Budapest, 1926; Hon. D.Sc., Princeton, Pennsylvania, Harvard, Case Institute, Maryland, Columbia, Univ. of Istanbul, Inst. of Polytechnics, Munich; 1926-29, asst. prof., Univ. of Berlin; 1929-30, asst. prof., Univ. of Hamburg; 1930-33, visiting lecturer and prof., Princeton; 1933-date, prof. math., Inst. for Advanced Study, Princeton; 1945-55, dir., Electronics Computer Proj., Inst., for Adv. Study, Princeton; 1955-date, A.E.C. Commissioner; mem. and con. many Dept. of Defense and AEC agencies, 1940-date; mem. Nati'l Acad. of Sciences and others; Bocher Prize, Amer. Math. Soc., 1937; Medal of Merit (Presidential award), Distin., Civ. Serv. Award, U. S. Navy, 1947; author "Mathematical Foundation of Quantum Mechanics," and about 100 technical papers.

A.F.C.A. MEETING

(Continued from page 5)

the program aboard the aircraft carrier, scheduled for the following day with a cruise off Quonset Point, R. I. Captain Bardwell's appearance will depend on whether his ship reaches port on June 14 in time for him to attend the meeting in Boston.

Navy's Program at Quonset, R.I.

The Navy's part of the program will cover most of the daylight hours of June 15. Male members of A.F.C.A. not to exceed 300, and 160 boys of age 14 or more who are sponsored by members, will proceed by bus to the U. S. Naval Air Station at Quonset Point, R. I. leaving the hotel in Boston at 6:00 a.m. sharp. Buses will start loading at 5:45 a.m. The adult members will board the carrier *Antietam* and the boys will be distributed aboard the four destroyers to participate in the day's exercises. The plan is thus to make the A.F.C.A. day with the Navy a "father and son" affair. A light breakfast will be served as the vessels get underway. On the *Antietam* a tour of inspection of the ship in small groups, displays of equipment, and briefing on operations will be followed by lunch in the General Mess. In the afternoon a program in antisubmarine training operations involving use of carrier-borne aircraft, gun fire, and depth charges will be carried out, using towed targets simulating hostile submarines. This part of the program will also be marked by a demonstration of precision formation flying by the Navy's famous exhibition team, known as the "Blue Angels."

The *USS Antietam*, the world's first aircraft carrier to be provided with an angled or canted flight deck, was commissioned on January 28, 1945. This great vessel, the second one to be named for the battle of Antietam in the Civil War, was prevented by time required for fitting out, trials, and crew training, from seeing action against Japan in World War II. However, after being placed in inactive reserve in 1949, the vessel was returned to active service from the "Mothball Fleet" in 1951 and was employed extensively in the Korean conflict. The *Antietam's* aircraft dropped approximately 5,000 tons of bombs on the enemy in those operations.

Ladies' Program

A great deal of time and effort by the Arrangements Committee have been given to preparation of the special program for wives and daughters of A.F.C.A. members attending the meeting.

On Thursday, June 14, there will be a special program limited to 100 women. (Enrollments will be made in order received.) This will be a day's bus trip to places of historic interest in and about Boston. A special charge of $5.00 per person making the tour will be collected aboard the buses. The trip will feature the House of Seven Gables at Salem, famed by Hawthorne's novel of that title. Luncheon will be at the Corinthian Yacht Club, Marblehead, Mass., and in the afternoon the group will visit Gloucester and Wellesley for a visit to the Babson Institute of Business Administration. Among noteworthy features of interest there is the Babson world globe 28 feet in diameter, an engineering marvel which took two years to construct. Mrs. Edward B. Hinckley, wife of the president of the Institute, will entertain the visiting women at tea at her home.

On June 15, the ladies will have an opportunity to spend the day at the Quonset Point Naval Air Station. They will proceed from the hotel in Boston by bus, leaving promptly at 9:30 A.M., and will arrive at the Air Station in time to see some of the installations there before dinner which will be served at noon in the General Mess. Among points of interest to be visited at this time is the Chapel, which is provided with a revolving altar.

A very full program of interesting events has been arranged for the afternoon. This includes a visit to the Operations building, the weather station, and the control tower where the ladies will be shown the various steps taken by pilots before take off. There will also be a tour of the Fleet Airborne Electronics Training Unit, to include a demonstration showing how pilots fly by instruments and also of how pilots counteract hurricane force winds, broken wings and meet other emergencies. There will also be a showing of the use of survival equipment for forced landings. If feasible at the time there will be a tour of ship. The "Blue Angels" flying show will complete the day's program. It is suggested that the women attending the Quonset program wear slacks and comfortable walking shoes.

For convenience of members the program in time-table form is presented below.

TIME TABLE FOR THE MEETING

Thursday, June 14

8:00 AM Registration: Hotel Somerset

Morning Session:

9:00 AM-12:30 PM	Princess Room, Hotel Somerset.
9:00 AM	Board of Directors Meeting (closed). Princess Room (air conditioned) Rear Admiral N. S. Prime, U.S.N. (Ret.), presiding.
11:00 AM	General Meeting — Princess Room Announcements; Awards; Address by Dr. Per K. Frolich, Chief Scientist, Chemical Corps, on Reorganization of the Corps.

Afternoon Session:

1:30 PM	Buses leave hotel for Kresge Auditorium, Massachusetts Institute of Technology, Cambridge, where the afternoon session will be held.
2:00 PM to 4:30 PM	Welcome by Dr. James R. Killian, Jr., president of M.I.T. Comments by Mr. Albert E. Forster, president of Hercules Powder Co., Wilmington, Del., presiding officer for the meeting. Paper—"Rocket and Satellite Exploration of the Outer Atmosphere"—by Dr. Joseph Kaplan, Chairman, U. S. National Committee for the I.G.Y., National Academy of Sciences, Washington, D. C. Paper—"Some Modern Concepts of Scientific Bases of Weapons Systems"—By Dr. John von Neuman, U.S. Atomic Energy Commissioner. Welcome and advance briefing for June 15 program by Captain Francis E. Bardwell, Commanding Officer *USS Antietam*.

(Following this session members have the following choice: (1) Immediate return to the hotel, or (2) Visit to M.I.T. Laboratories, or (3) Visit to Babson Institute of Business Administration before returning to the hotel.

Friday, June 15

Morning and Afternoon:

Program by U. S. Navy at sea off Quonset Point Naval Air Station, Quonset Point, R.I., consisting of regularly scheduled antisubmarine defense training activities involving gunfire, use of depth charges, and smoke screening by destroyers, and also naval aircraft operations. Cameras will be allowed.

5:45 AM	Buses load at Hotel Somerset for Quonset Point. (This program is limited to 300 male members of A.F.C.A. and 160 boys, sponsored by members, and registered in advance.)
8:00 AM	Embarkation: Adult visitors board the *USS Antietam*, aircraft carrier. boys (age 14 and above) board the four destroyers to participate in the exercises. Light breakfast provided aboard ship; vessels get underway.
9:00-10:00 AM	Tour of ship in small groups.
10:00-11:00 AM	Destroyer operations—Gunfire, depth charges, smoke screening.
11:00-12:30 AM	Lunch—General Mess.
1:00- 4:00 PM	Fleet Operations — Launching from carrier of both propeller-type and jet aircraft; rocket and dive bombing attacks on towed spar target; simulated air attack on carrier (Navy jet fighters operating from Quonset.) Recovery of aircraft previously launched from the carrier. Static display of Navy protective gear. "Blue Angels"—precision formation flying program by famous naval flight demonstration team operating from Quonset.
4:00- 5:30 PM	Debarkation at Quonset Point, embussing and return to Hotel Somerset.

(In case of inclement weather a full day's program of interesting displays and demonstrations aboard the aircraft carrier in port has been arranged for.)

6:30- 7:00 PM	A.F.C.A. president's reception and cocktail party—Hotel Somerset.
7:30 PM	Banquet, Hotel Somerset Program:

National Anthem—Color Guard—Music

Invocation—Dr. Edward B. Hinckley, president of the Babson Institute

Introduction of special guests—Meeting Chairman Harry A. Wansker

Introduction by A.F.C.A. president, Rear Admiral N. S. Prime, USN (Ret.) of the banquet speaker, Hon. Clifford C. Furnas, Assistant Secretary of Defense (Research and Development).

Introduction by President Prime of the president-elect for the ensuing year.

LADIES' PROGRAM

Thursday, June 14

8:45 AM	Buses load at Hotel Somerset for tour of historic Salem, Gloucester, Marblehead, etc., including visit to House of Seven Gables, Salem.
12:00- 1:00 PM	Luncheon at the Corinthian Yacht Club, Marblehead, Mass.
1:30 PM	Buses leave for Gloucester and Wellesley, Mass.
3:00- 4:30 PM	Tea as guests of Mrs. Edward B. Hinckley, wife of Dr. Hinckley, president of the Babson Institute of Business Administration, Cambridge, Mass. Visit to Institute to see the Relief Map and World Globe (largest in the world).

Friday, June 15

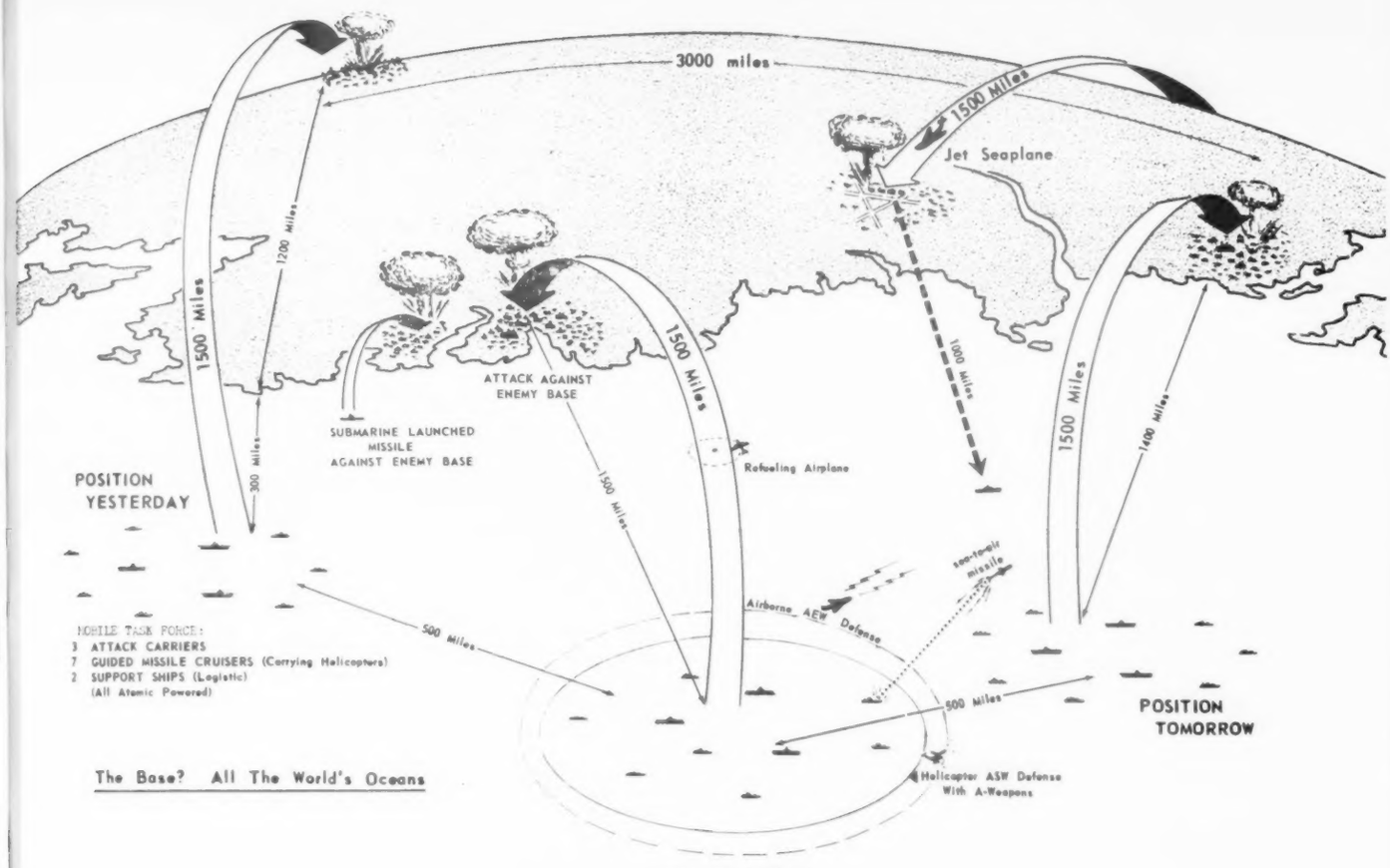
9:30 AM	Buses leave Hotel Somerset for Quonset Point, R. I.—Naval Air Station
11:30 AM	Visit to Station Chapel (Welcome, and demonstration of the revolving altar).
12:00 Noon	Dinner with crew in General Mess.
1:00- 4:15 PM	Programs of visits to various installations to see phases of naval pilot training, including weather station, control tower activities, use of instruments for flying, pilot action in various emergencies, use of survival equipment. Visit aboard ship if feasible; "Blue Angels" precision formation flying demonstration. Return by bus to Boston for A.F.C.A. reception and banquet at Hotel.

A.F.C.A. MEETING CHARGES

Registration (all attending	$ 2.00
Men and Boys (registration included)	
Full program	25.00
Quonset program only	12.00
Reception and Banquet only	15.00
Women and Girls (registration included)	
Full program (except special bus tour)	21.00
Special Bus Tour (100 limit)	5.00
Quonset program only	8.00
Reception and Banquet only	15.00

Advance reservations, to be listed in order received, will close May 1, 1956, after which date no cancellations and refunds can be made. Banquet tables for 10 or 12 persons can be reserved. Formal dress for banquet is optional. Seatings for the banquet and authorizations for attendance at other events will be made at the Registration Desk, Hotel Somerset, commencing evening of June 13 on basis of available spaces.

Send reservation requests to Mr. Chenery Salmon, Merchants National Bank, P. O. Box 2197, Boston 6, Mass., with check made payable to N. E. Chapter, A.F.C.A.



HOW THE MOBILE SEA BASE SYSTEM COULD FUNCTION IN NUCLEAR WARFARE*

This drawing illustrates the potential of sea power in nuclear warfare of the future. Note that in three days' time a mobile task force could launch concentrated attacks on fixed military installations 3,000 or more miles apart, and that those attacks could be supplemented by, or independent of, simultaneous strikes by submarine-launched guided missiles or jet seaplanes.

MOBILE SEA BASE SYSTEMS IN NUCLEAR WARFARE*

By JAMES H. SMITH, JR.
Assistant Secretary of the Navy (Air)

IT IS INCREASINGLY evident that nuclear warfare is refocusing attention upon the need for a military force based on the high seas. Rather than diminishing the future value and need of a Navy, the advent of the atom, like that of the airplane, has reemphasized the importance of seapower.

In modern warfare the offense has taken a commanding lead over the defense. This lead is a product of the nuclear weapon and its sharply increased *lethal radius*. Even so, a reasonable defense against nuclear explosives might be devised, were it not for the tremendous increase in the *speed* of the vehicle delivering the explosive. The speed of these vehicles—whether they are today's supersonic jet bombers or tomorrow's long-range missiles—reduces the warning period before an attack and, consequently, the time in which we can bring our defense to bear. The destruction of the attacker is therefore up to defenses that are already in place.

A handful of men operating offensive, nuclear weapons today can do more damage than an entire army in the past, and they can do it at a distance of thousands of miles from their home base and within hours (ultimately, minutes) of the decision to attack. Even against a 90 per cent effective defense—an almost incredible effectiveness level—they could probably achieve a *rate* of destruction critical to the defender.

It would be hard to estimate what per cent of effectiveness could be achieved by the defense against an enemy jet bomber attack. It is known that against future missiles of the improved V-2 type there is no practicable defense. Against those prospective missiles the only solution—

A graduate of Harvard College and of Columbia University Law School, Secretary Smith was designated a naval aviator in 1932. During World War II he served as a pilot in scouting and torpedo squadrons flying off the *Yorktown* and *Belleau Wood* and later served on carrier divisional and task group staffs in the Pacific. A vice-president of Pan American World Airways (1946-49) and Director of Slick Airways (1949-53), he was appointed Assistant Secretary of the Navy (Air) in July, 1953.

and against today's weapons a more effective solution—is to destroy the bases from which they might be launched.

These facts lead to several conclusions which appear valid for the medium term future:

First: The offensive can inflict devastating results despite any foreseeable defensive effort.

Second: The best defense is an overwhelming counter offense, directed primarily at the bases and sources of the enemy striking forces.

Third: National security, unless one can be sure of striking first, lies in convincing an enemy that even if *he* strikes the first blow, he cannot prevent an overwhelming and possibly fatal counterattack against his air power and other nuclear weapons potentials.

Since it is the consistent policy of the United States not to initiate preventive war, it is plain that our determent of war before it starts (and our survival if it does) depends on our ability to counterattack promptly and with great force and precision no matter how severe the enemy's initial attack. Such a defense requires two things: First, the United States' long-range weapons and their delivery systems must remain adequate in numbers and second to none in quality. Second, the bases from which these weapons are launched must neither *be* nor *appear to be* vulnerable to an enemy's initial attack. This last requirement cannot be over-emphasized. The present contest is not a game in which the aces are hidden. The enemy must know and know well that his best calculations and best efforts cannot earn him immunity from a blow of magnitude equal to, or greater than, that which he has attempted.

Therefore, the security of the base system from which our retaliatory attack is launched is a major concern of our military planners. To compensate for the limited range of our present bombers and missiles, we now have bases well advanced toward the enemy targets. Yet fixed bases on foreign soil in close proximity to the enemy cannot always be used—because of problems of sovereignty. Nor can they be defended adequately. In these advanced locations they offer the most obvious, immovable, exposed targets for surprise attack by relatively short-range enemy nuclear weapons.

The concentration of all the Services on increasing the range of our weapons steadily reduces our dependence on bases near the target. However, a corresponding increase in range of enemy weapons would also make even our immovable home bases vulnerable to sudden overwhelming attacks which could prevent our counterattack.

In a recent magazine article General Charles A. Lindbergh pointed to the vulnerability of air bases as a weak spot in our atomic deterrent potential. He emphasized the importance of decentralizing and scattering our bases to prevent their simultaneous destruction. He assumed quite logically that we cannot conceal the location of our land bases from enemy intelligence agents.

On the other hand, *sea* bases can be readily decentralized and scattered and their location *cannot* be predicted by the enemy. This is of great importance because long-range pilotless missiles such as those developed from German V-1 and V-2 types (which will be among the major threats to our fixed land bases in the future) *cannot be used effectively against moving targets.* This is a fundamental weakness inherent in the guidance problem for very long-range missiles. This weakness confers a very great advantage on the nation that invests a goodly share of its deterrent and retaliatory potential in forces operating from mobile bases.

It is therefore submitted that:

1. Our defense in nuclear warfare must be based primarily on a well-advertised ability and intention to counterattack with overwhelming force.

2. For maximum assurance against a surprise attack at least a part of the United States' counterattack potential must be decentralized and dispersed far and wide on *moving bases.* This might be called an ultimate or an additional deterrent, supplementing our fixed-base striking forces. In any event it is so important that *if we do not have mobile sea bases we should be forced to invent them.* Fortunately we have them.

The most practical *moving base* for an offensive weapon today is that which moves on water. There are several such bases. It can be a surface ship such as the carrier or it can be a submarine from which aircraft or missiles are launched, or simply the sea itself from which seaplanes supplied by mobile tenders operate against the target. Moving bases may eventually shift to the air, but such a development requires endurance in aircraft beyond anything presently in sight. For today's use, inventing an American *mobile* deterrent force for the atomic age is not necessary. Because the Navy has not lost sight of the strategic and tactical value of mobility which the sea provides, naval power stands squarely in the road to meet future national strategic requirments.

On this faith in the enduring virtues of mobility the American carrier striking force was founded. That force is mobile deterrent power *today.* Furthermore, carrier forces have the additional virtue, uncommon these days, of diverting enemy intentions and weapons away from our populated areas and out to sea. This is extremely important when considering such things as radioactive "fall out."

The mobile deterrent forces the United States will need must have three characteristics. First, they must have the ability to deal devastating blows precisely—a high rate of destruction against the enemy's striking power. Second, they must be self-sustaining for periods sufficient to render overwhelming injury to the enemy, so that even if our shore bases are destroyed they can still continue from the far seas to hurl destruction at the enemy's military vitals. Third, although invulnerable to long-range pilotless missiles, they must still be defensible against the modern humanly guided weapons.

Those are the three characteristics which must mark the carrier striking forces of today and tomorrow.

Future carrier striking forces can be visualized as a handful of large ships able to maintain high speeds in all sea conditions—say, three carriers, seven guided missile cruisers, and two high-speed resupply ships per task force. This small task force may be contrasted with the 100-ship Task Force 58 of World War II and its many dozens of logistic support ships. This handful of a dozen ships will be far more economical, yet more powerful and more mobile. The ratio of punch to overhead will be tremendously improved.

This mobile force will be spread out over an ocean area the size of the State of Maine. It will be so widely dispersed that no single weapon, of any size now visualized, can seriously damage more than one ship.

Such a force would pack a very great offensive punch. It would include aircraft able to deliver large yield weapons under all weather conditions against enemy bases 1500 or more miles distant. It would have other smaller supersonic aircraft, each able to deliver in the medium ranges a weapon large enough to knock out an opposing air base or missile site. Coordinating with such carrier forces will be advanced forces of nuclear-powered submarines, launching atomic missiles against targets at relatively short ranges.

These forces would be self-sustaining for some thirty

(Continued on page 15)

A. F. C. A. Membership Key

May we present our new mark of membership in the Armed Forces Chemical Association—a beautiful key!

There is no regulation governing the manner in which the key may be displayed. That is a matter to be determined by each individual. We show it here suspended from a tie-clasp chain. It seems likely that this may prove the most popular manner of displaying the key.

The key and or clasp may be ordered by properly accomplishing the form shown below and mailing same with a check to cover cost of items desired.

ORDER FORM

Armed Forces Chemical Association
Suite 819, Park Lane Building
2025 Eye Street, N. W.
Washington 6, D.C.

Please send me items checked to address below

	Price
☐ Key—sterling silver . . . $2.65 + Fed. Tax	$2.92
☐ Key—1/10th 10K double rolled gold plate $4.15 + Fed. Tax	4.57
☐ Key—10K yellow gold . . . $7.50 + Fed. Tax	8.25

Engraving of up to five initials on back of key may be included without charge.

*Tie clasp as shown without key:

☐ Sterling silver $2.00 + Fed. Tax	2.20
☐ 1/20th 10K yellow gold $2.75 + Fed. Tax	3.03

*Tie clasp is a standard stock product of a nationally known jewelry and insignia firm. It is listed herein solely to assist our membership and without profit to the Association.

Where state sales tax is applicable, it must be added to above figures.

Remittance of $ _____ is enclosed herewith.

Initials desired _____
(Please indicate clearly)

Name _____

Address _____

RANDOLPH MONRO RETIRED

Mr. Randolph Monro, 66, who is believed to have had more continuous experience in gas mask development than any other man in the United States, recently retired at Army Chemical Center, Maryland, after 40 years of government service, most of it with the Chemical Corps of the Army. Brigadier General John R. Burns, Center commander, commended Mr. Monro for many achievements, including the important part he played in developing the gas mask carried by the Armed Forces in World War II. Mr. Monro's first experience with the masks came in 1917 after his enlistment in the National Army. He was assigned to Gas Mask Production because of previous engineering experience. A native of California, he attended the University of California before entering the Federal service in Washington, D. C. in 1914. Mr. Monro resides at Mountain Village in Harford County, Md. He is a past secretary-treasurer of the Army Chemical Center Chapter of A.F.C.A.

A.F.C.A. $1,000 AWARD

Chapters are reminded that nominations of outstanding secondary school teachers of mathematics or science as candidates for the A.F.C.A. $1,000 award (see January-February 1956 issue) are due at National Headquarters by midnight

March 31, 1956

MOBILE SEA BASES

(Continued from page 12)

days of war operations, a long time in terms of atomic war. Most of the ships would have nuclear propulsion. Aviation fuel and weapons re-supply would come from the two fast supply ships traveling with each task force.

Because of the dispersion of the force's ships and the range of its weapons, such a carrier force could exert a tight and exclusive control over an area of 60,000 square miles—the six New England States rearranged into a circle 275 miles in diameter. An enemy vessel or aircraft would approach that area at its peril and few would live to penetrate even part way to its center.

In the past, fast carrier task forces have been satisfied to have one or two cracks at the enemy attackers. Anti-aircraft and antisubmarine defenses have been tightly concentrated around the carriers for mutual reinforcement. Combat air patrols were dispatched to break up enemy attacks 50 miles out. Against the Japanese this was enough. In one day alone— the Marianas Turkey Shoot— the Japanese threw 545 aircraft against such a formation and had 366 shot down. Against nuclear attacks even this high performance is unacceptable, even though it is not expected that the mobile deterrent force would face such numbers.

Against air attack, the future carrier force would have a defense system unrecognizable when compared to that of our World War II Task Force. Short range anti-aircraft weapons would be absent because they have been made obsolete by the distance from target to release point in modern high-speed bombing. Instead, defense against air attack would in great part depend on medium range guided missiles carried aboard the cruiser missile ships. Nuclear warheads would be available for missiles fired against large bomber formations, should the enemy be unwise enough to concentrate his aircraft.

Against enemy submarines there would be concentric rings of warning and defense, provided primarily by helicopters based on the guided-missile cruisers. The outer ring would be effective many miles from the carriers. Nuclear anti-submarine weapons would also be available. The use of destroyers will be entirely different from the procedure of World War II and probably none would be employed in a carrier task force.

This exploration of the potential capabilities of future carrier defense has been mentioned in some detail because of the prevailing feeling that carriers are easy to sink. Those who share that feeling fail to distinguish between putting a carrier out of action and stopping the carrier *force* as a whole. In the defense of the modern carrier task force, the objective will be to stop *all* attackers before they reach release position. A failure will not sink the entire force, although it may knock out any one ship.

But the unpleasant fact of nuclear war is that today practically everything is vulnerable, particularly airfields. Nuclear tests tell us exactly what size atomic bomb is required to lower the center of any man-made runway in the world to a depth of 100 feet. Any runway so attacked will stay sunk. But it is obvious that of the two bases—fixed and mobile—the latter has a far greater chance of survival.

The sea base, moreover, has other important advantages:

First, it enjoys unobstructed radar vision.

Second, the location of that sea base cannot be predicted. The location of the carrier *force* will not be a secret, but within its vast dispersed control area the *carrier* location will be obscure. Moreover, the carrier task force's defense system will be especially designed to limit enemy reconnaissance.

(Continued on page 35)

THE RESERVE PROGRAM

On pages 17 and 18 there is presented correspondence between Under Secretary of the Army Charles C. Finucane, then Acting Secretary, and A.F.C.A. having to do with the Army Reserve and also a message from President Prime to the Association's members, calling for their opinions on the Reserve program. Letters similar to that received by the A.F.C.A. were sent out by the Army to various other organizations and agencies devoted to national defense interests, and the Army has now launched an "all-out" publicity campaign to promote understanding, particularly on the part of the youth of the nation, of the Armed Forces Reserve Act of 1955.

To assist A.F.C.A. members, who may not be familiar with the new law, in replying to President Prime, we are pleased to reprint here a concise but comprehensive article by Captain Glasser from the special number of the Army's magazine, *Army Information Digest*, issued in Febraury and devoted exclusively to various aspects of the Reserve program. The Army is especially interested in the provision of the Act for enlistment of young men of 17-18½ years in the Ready Reserve to serve on active duty for training for six months, the balance of their Reserve obligation to be met by service in an organized Reserve unit.

A.F.C.A. members who are concerned with the utilization of technical manpower will be interested also in the two Executive Orders pertaining to the Reserve, signed by the President on January 6, 1956. One of these prescribes Selective Service regulations under which registrants having critical skills pertaining to a critical defense-supporting industry or a research activity affecting national defense may be enlisted for three to six months active duty, the balance of their obligation to be met in the Stand-by Reserve. The second Executive Order pertains to the screening of personnel in the Ready Reserve by the Armed Forces to insure that persons having critical civilian skills and who are in excess of the number with such skills required in the Ready Reserve will be transferred to the Stand-by Reserve.—Editor.

Toward a more effective Reserve

THE RESERVE FORCES ACT OF 1955

***By* CAPTAIN ANTHONY P. GLASSER**

(Reprinted from Army Information Digest, Feb. 1956)

AS FINALLY ENACTED, the Reserve Forces Act of 1955 (Public Law 305—84th Congress) was not intended to be a complete revision of existing laws on the Reserve program. Instead, it changes and amends two earlier laws—the Universal Military Training and Service Act of 1951, and the Armed Forces Reserve Act of 1952.

The 1951 Act extended the term of service for draftees from 21 to 24 months, and prescribed a total active and reserve military service obligation of eight years. The 1952 Act created the three reservist categories of Ready Reserve, Standby Reserve, and Retired Reserve, which fixed the liability for future active duty and sought to prevent inequities in the future recall of reservists.

Weaknesses in the program apparent since 1952 led to the corrective measures embodied in the Reserve Forces Act of 1955. As President Eisenhower stated to the Congress, these deficiencies were:

A weak reserve structure and organization.

Too few means of manning the Reserve Forces without at the same time weakening the Active Forces.

No means of giving the National Guard a fair share of trained personnel.

No means of insuring that men released from active duty would comply with the obligation to train in the Reserves.

To devise a law responsive to all these problems was only part of the task facing the lawmakers. While steps were being taken to strengthen the Reserve, it was also necessary to maintain the combat effectiveness of the Active Army. Sufficient military manpower had to be made available without disrupting the industrial effort which supports that military power. Finally, it was necessary to assure that the Reserve obligation would be shared equally by all qualified young men of the Nation.

The Reserve Forces Act of 1955 makes improvement in four different aspects of the Reserve program:

1) It enlarges the size of the Reserve and clarifies the reserve structure.
2) It establishes a clear obligation to train as a reservist and provides the means of insuring that reservists comply with their training obligation.
3) It provides ways for young men to enlist and train specifically for the reserve components.
4) It creates a shorter total military obligation for persons entering the service after enactment of the law.

Structure and Size of the Reserve

The Nation's total Reserve Forces consist of seven components—The National Guard of the United States, the Army Reserve, the Naval Reserve, the Marine Corps Reserve, the Air National Guard of the United States, the Air Force Reserve, and the Coast Guard Reserve.

Although the size of the Reserve is changed by the Act, its foundation is still the *Ready Reserve* and the *Standby Reserve*.

Ready Reservists continue to be the only Reserve personnel who may be ordered to active duty in an emergency *proclaimed by the President*. However, the law limits to one million the number of Ready Reservists that may be ordered in this manner. This number could be increased only by Congressional authority.

Both Ready Reservists and Standby Reservists may be ordered to active duty in case of war or an emergency *declared by Congress*. However, Standby Reservists would be subject to service under a system of "selective recall."

In short, Ready Reservists are in training and are subject to immediate orders in event of an emergency. Standby Reservists, who do not drill or train, are ordered only in a Congressionally-declared emergency and only after being declared available through the "selective recall" process.

Under the Act, the authorized size of the Ready Reserve is increased from 1½ million to 2,900,000. The Army's part of this new total is 1,692,000.

(Continued on page 19)

Captain Anthony P. Glasser, Infantry, is on duty in the Troop Information and Education Division, Office of the Chief of Information and Education, Department of the Army.

A LETTER FROM PRESIDENT PRIME

About the Reserve Forces Act of 1955

Dear A.F.C.A. Member:

Our Government faces a situation demanding action. It has asked us, meaning you and me, as Americans, to help. In early 1955, your elected representatives in the Congress of the United States made into law an act known as the "Reserve Forces Act of 1955." The Act, which became law, varied in a particularly important respect from that which the Department of Defense had requested of the Congress. Your representatives decreed that the Armed Forces could not order, direct, or enforce any person to apply for or to go into the Reserve program as his initial induction into the Armed Forces. Instead, the Armed Forces are required by the law to accept such application on a purely voluntary basis.

The response of the youth of America in the 17-18½ year age group has been extraordinarily light. Undoubtedly there are a great many reasons for this lack of enthusiasm on the part of young America for this program. Among these, almost certainly, is the fact that advertising and promotional information of the provisions of the Act have been inadequate.

You and I are Americans. As Americans, we are subject to the law. As Americans, we are also subject to the necessity for preserving our institutions and our lives. The United States has, ever since it became a nation and even before it became a nation, operated its defense forces on the general basis of maintaining a small Regular Army and of maintaining Reserves, militia, National Guard, and other non-active but partially trained personnel whose function was to speedily, in the event of war, augment the Armed Forces and fabricate a successful fighting group. You are all sufficiently old to know that in this life we cannot eat our cake and have it too.

If the Reserve Forces Act of 1955 has yet to achieve the interest among 17-18½ year olds available for service because of the very, very inferior publicity and salesmanship which has so far attended its birth and nurturing period then let us awaken ourselves and our youngsters to the provisions of the Act and let us help the Army to attain its Reserve objective.

As I have indicated in my letter to the Honorable Charles C. Finucane, I feel that I have not the right to answer him as your representative without first having heard from you. Give, then, some thought, some time, and some consideration to this Act which is a part of our statute law. When you have done so, please write to me and tell me what you think. Let me know how you think the law should be implemented. Let me know how you think the boys and their fathers should be informed. Let me know what your section of America is thinking about the defense of the United States. I assure you that I will bring to the Secretary a report and analysis of your replies which will inform him as to the concern of the Armed Forces Chemical Association and as to its recommendations to him.

Sincerely yours,
NATHANIEL S. PRIME
Rear Admiral, U. S. Navy (Ret.)
President

Sec'y. Finucane's Letter and Reply by President Prime

December 15, 1955

Colonel John C. MacArthur (Ret.)
Editor, Armed Forces Chemical Association
2025 Eye Street, N.W.
Washington, D.C.

Dear Colonel MacArthur:

The Department of the Army is soliciting the comments of several of America's most outstanding business and professional organizations on a matter of vital concern to our nation. The problem of a virile Reserve force to augment the active defense establishment is one worthy of your most serious consideration.

I do not know whether you have yet had the opportunity to become fully familiar with the Reserve Forces Act of 1955. For your information and because I know that you and your membership are interested, I am taking the liberty of inclosing a copy of the Act. This legislation is designed primarily to establish and to maintain adequate Reserve Forces which can effectively augment our Active Forces and to assure the minimum impact on essential civilian businesses, industrial and agricultural activities, while at the same time it seeks to provide the maximum equity of military obligation for all qualified young men. I am certain you will agree that the most important consideration is that the Act, as it is implemented, will go a long way toward providing our country with the ready and reliable Reserve which is essential to our security. In order to be reasonably safe without such a Reserve we would be forced to maintain a far larger standing Army than we have at present. I am confident that your organization, in its continuing endeavor to champion the best interests of our nation, will want to render full assistance to insure a successful implementation of this vital legislation.

One of the major provisions of the new legislation concerns the enlistment of young men between the ages of 17 and 18½ into units of the Army Reserve. These young men are required to take six months active duty training and then participate with a Reserve unit for 7½ years. We are placing special emphasis on this program because its success will determine in large measure whether or not we will be able to develop fully-manned Reserve units. The success of this six months training program will also determine whether or not we must continue to rely upon veterans and impose upon them a disproportionate share of our military obligation as in the past. Several thousand young men have already volunteered for this program; many additional thousands are needed.

It would be particularly helpful if we could get your reaction to this program and any suggestions which you feel might be useful in stimulating our recruiting program. I am inclosing for your information a fact sheet and a booklet containing detailed data on the new Reserve Forces legislation. Should you decide that the inclosed material could be utilized by your organization, we would be pleased to furnish as many copies as you desire. We also have available a fine speaker's guide on this subject and would be happy to furnish a qualified speaker from the Department of the Army for such occasions as you may deem appropriate.

The Department of the Army will be very appreciative of your assistance and cooperation.

Sincerely yours,
CHARLES C. FINUCANE
Acting Secretary of the Army

4 Incls.

December 30, 1955

The Honorable Charles C. Finucane
Acting Secretary of the Army
Department of the Army
Washington 25, D. C.

My dear Mr. Secretary:

Your letter of December 15, 1955, addressed to Col. John C. MacArthur (Ret.), Editor of Publications of this Association, has been brought to my attention for consideration and reply.

I think, Mr. Secretary, that I would be presumptuous should I present to you my individual opinion rather than a composite of the general opinion of our membership in this matter.

Your problem is a problem which concerns all American men of draft age and all fathers of boys who now or later will enter the 17 to 18½-year age group. Although it will take a period of time to do so, I intend to determine, if possible, the thinking of our membership concerning the Reserve program and this will be committed to you as soon as it shall have been made evident to me.

Specifically, I propose to publish your letter to Col. MacArthur and this letter together with a personal letter from me to the membership. In that letter I will request their views and I expect that I will have considerable response from the membership. I undertake to analyze this response and to report to you upon it.

Very sincerely yours,
NATHANIEL S. PRIME
Rear Admiral, U.S. Navy (Ret.)
President

ARMED FORCES DAY

The annual celebration of Armed Forces Day will be held throughout the nation this year on May 19. The one-day program of demonstrations, exhibits, and receptions at Armed Forces installations was established by the Secretary of Defense with the President's approval in 1949. This one-day celebration took the place of three previous separate celebrations—Army Day on April 6, Air Force Day on September 18, and Navy Day on October 22.

Since this celebration was inaugurated there has been a progressive increase in the number of programs and attendance. In 1953 with 500 "open house" programs throughout the country it was estimated that the attendance was 4 million. In 1954 the programs were increased to more than 2300 and the attendance reached 7 million. Last year with 2500 such programs at posts, camps, stations, air bases, ships in port, armories, reserve stations, etc., the attendance was more than 7,500,000.

In the President's proclamation for Armed Forces Day in 1955 he stated in part as follows: "I call upon my fellow citizens not only to display the flag of the United States on Armed Forces Day, thus manifesting their recognition of the sacrifices and devotion to duty of the Armed Forces, but also to avail themselves of this opportunity to further their knowledge of our defense system and of the men and women who constitute its real strength, by attending and participating in the local observances of the day conducted by the Armed Forces and the civil authorities."

RESERVE ACT *(Continued from page 16)*

The Ready Reserve, primarily made up of organized units, is designed to contain the reserve forces needed to meet requirements during the first phase of a war or general mobilization. In addition, forces needed to augment the Active Army during an emergency that does not involve war or general mobilization will be drawn from this category.

The Standby Reserve is designed to contain those additional reserve forces that would be needed in case of war or general mobilization. It is not made up of units; instead it is a large "pool" of trained men whose skills and experience would be needed in the emergency.

The Screening Process

The Act directs "a system of continuous screening of units and members of the Ready Reserve . . ." By this process a reservist is placed in either the Ready Reserve or the Standby Reserve.

Use of the screening process is expected to have the following advantages:

1) In event of mobilization, personnel and units in the Ready Reserve will be immediately available and fully qualified for active duty. These units will not contain men who have critical jobs in civilian industry; they will have no men who are over-age, or who fail for any reason to meet the qualifications for active service.
2) Men with certain needed military skills will be available for active duty in the required numbers. For example, the Ready Reserve will not have a shortage of radio operators and a surplus of wheeled vehicle mechanics.
3) Men with critical civilian skills will not be kept in the Ready Reserve unless those skills are actually being used to meet a military requirement.
4) Combat veterans are less likely to be ordered to active duty.
5) Men will be transferred to the Standby Reserve in cases of extreme personal or community hardship. Thus a reservist will not be ordered to active duty if he is more important to the Nation in his civilian job than in his military duty.

The "screening process" can work in reverse, too. Suppose that a man has been transferred to the Standby Reserve because he is employed in a critical defense job. Then he quits defense work to take a position as an automobile salesman. Since his new job is not considered critical, the "screening process" would result in his transfer back into the Ready Reserve.

Selective Recall

Under this newly instituted system, a man in the Standby Reserve may not be ordered to active duty against his wishes until the Selective Service System decides whether or not he is available.

Selective Service determines such availability by seeking the answer to the question: Is this man more important to the United States in the Army or in his civilian job?

Another value of the "selective recall" provision is the fact that it helps to assure a fair distribution of skilled manpower between military and essential civilian defense requirements.

Required Reserve Training

To implement the existing reserve training obligation, the Act provides specific measures to insure that reservists comply with it.

Under the old law, men transferred to the Ready Reserve were not required to participate actively in reserve training. Under the new law, however, men who acquire a Reserve obligation after 9 August 1955, are (with certain

(Continued on page 36)

Painting by Stanley Arthurs shows Thomas Jefferson, right, urging E. I. du Pont de Nemours to go into powder business. Paul Revere, second from left, was at 1801 meeting; shown standing, Maj. Gen. Henry Dearborn, Secretary of War. Jefferson was responsible for du Pont's first order—refining saltpeter for the government.

THE DU PONT COMPANY AND NATIONAL DEFENSE

By JAMES Q. DU PONT

Administrative Assistant, Public Relations Department
E. I. du Pont de Nemours & Company, Inc.

THE DU PONT COMPANY was founded in 1802 to manufacture black powder, needed by the young nation for hunting, land clearance, mining, quarrying, and self-protection.

In 1802 Du Pont was a small community of six owners and a few score employees brought together to make a single product. The United States was a small country with 5,000,000 people, of whom 75 per cent were engaged in agriculture. The century and a half that followed saw both the Du Pont enterprise and the nation expand far beyond the narrow borders that confined each in 1802. Du Pont grew because the growing nation's needs and its free traditions encouraged progress. The nation grew because it was a haven of freedom and its new industries were contributing the seeds of growth that germinate in daring, risk, and innovation.

The interests of Du Pont, like those of the nation, have always been with peace. It is in peacetime that the company has been free to follow the profitable lines of commercial endeavor that have helped it grow from the manufacturer of a single product to the largest producer of diversified chemicals and chemical products. Yet the very nature of its business has made the company essential to national defense, and it has responded, as every citizen should, to each national emergency as it arose.

The company's founder was a young Frenchman, Eleuthère Irénée du Pont de Nemours, who had served an apprenticeship under Antoine Lavoisier, greatest chemist of his day and superintendent of the French government gunpowder plant at Essone. Yet he had no thought of gunpowder when he came to America in 1800 as a political refugee. He had a number of grand plans, chief of which was establishment of a Virginia colony where Frenchmen like himself could start life anew. One by one, the plans proved impracticable. At the same time, Irénée du Pont was shocked by the poor quality of American gunpowder and impressed by the need for good powder. Here was his opportunity.

President Thomas Jefferson, mindful of the defense needs, encouraged him to build a powder mill and suggested that it be situated near Washington. After a trip to France to raise $36,000 in capital, Irénée set about looking for a site. He explored the country around Washington, inspected locations in Pennsylvania, New Jersey, and New York, and finally purchased a 95-acre farm on the banks of the Brandywine near Wilmington. There, on July 19, 1802, he began construction of his first mill.

A YEAR LATER THE MILL was ready for operations. A letter from Irénée to Thomas Jefferson resulted in an order from the Secretary of War to refine a quantity

This is the third of a series of articles on the history of sustaining member companies of A.F.C.A. which reflect the vital role of the chemical industry in National Defense.—Ed.

of saltpeter in the government's possession. It was not until 1805, however, that the first order for new powder was received from the government. In that year, the Du Pont mills supplied 22,000 pounds of powder for the American frigates sent to Algeria to suppress the Barbary pirates—the first Du Pont powder used in actual military operations.

In the years following, relations with England became increasingly strained. Since it was the government's practice to furnish its own saltpeter for the manufacture of gunpowder, Irénée du Pont warned President Madison of the difficulty of importing saltpeter from India in time of war. The government bought and stored $50,000 worth of Indian saltpeter, a timely action that resulted in an eventual saving to the government of about $500,000.

The War of 1812 brought large orders which necessitated expansion of the mills on the Brandywine. For the ground forces, 50,000 pounds of powder were ordered late in 1811, 200,000 pounds in 1812, and 500,000 pounds in 1813. Additional quantities had to be made to supply the needs of the Navy, which bought through its own agents, usually from local dealers in the principal ports.

Already under pressure from his French stockholders for a return on their investment, Irénée was forced to strain his credit to the utmost to finance expansion of the mills. His situation was not eased by the fact that the government itself was financially embarrassed, and it was with great difficulty that manufacturers obtained payment for supplies furnished to the government. Yet he kept his credit alive and delivered the gunpowder.

Irénée never did work his way entirely out of debt, but he built a company that grew stronger every year. He made a product that was needed, he constantly improved its quality, and through manufacturing efficiencies was able to reduce prices and so expand his market. Before the War of 1812, good imported powder sold for 40 cents a pound. In 1827 it sold for 26 to 30 cents, but American powder of equal quality could be bought for 16 to 20 cents. More than any other one man, Irénée du Pont was responsible for the change.

By 1832, the Du Pont mills had an annual output of 850,000 pounds, believed to be about one-seventh of the national total. It was at this time that an event occurred which set a precedent which has been faithfully followed. The State of South Carolina threatened to secede from the Union in protest against the "tariff of abominations." Ready to resist federal attempts at enforcement of the tariff by force, South Carolinians sought to buy powder from Du Pont. Irénée wrote to his agent on January 12, 1833:

"We have duly received your favor of yesterday transmitting an order from C. R. Holmes, of Charleston, South Carolina, for 120,000 pounds of cannon, musket and rifle powder, to be paid cash and shipped by the 24th inst. at Philadelphia on board a vessel for Charleston. The destination of this powder being obvious, we think it right to decline furnishing any part of the above order. When our friends in the South will want sporting powder for peaceful purposes we will be happy to serve them."

IT WAS IN THE FOLLOWING year, a year in which the mills on Brandywine produced more than 1,000,000 pounds of black powder, that Irénée du Pont died. Under his son-in-law, Antoine Bidermann, and then his eldest son, Alfred Victor du Pont, the company continued to expand. The last of the French stockholders were paid off in full. The panic of 1837 called for careful management, but the 1840's brought so much industrial construction, building of canals and railways, and mining, that there was ever increasing demand for Du Pont blasting powder. So great was the expansion that although the company was called on to supply approximately 1,000,000 pounds of powder for the Mexican War, this represented only about one-fifth of the output of its mills for the period.

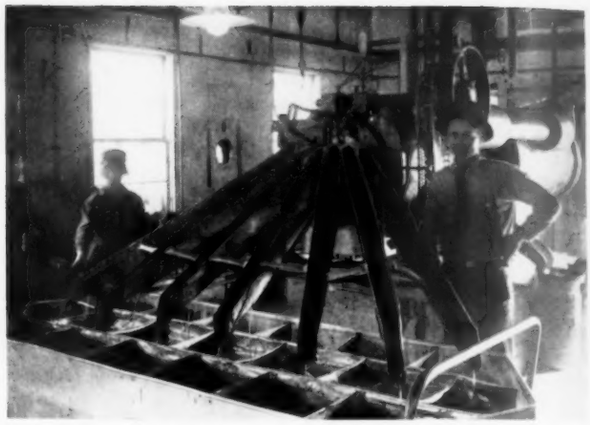
Alfred du Pont followed his father's precedent when, a few weeks after the start of the Mexican War, a firm

James Q. du Pont stands by an arch of one of the earlier powder mills of the Du Pont Company, established by his great-great grandfather, E. I. du Pont de Nemours, in 1802.

JAMES Q. DU PONT

James Q. du Pont, a great-great-grandson of E. I. du Pont de Nemours, founder of the Du Pont Company, joined the company in 1940 as a construction engineer. In 1943, he was assigned to the company's Explosives Department for work on the atomic energy program at the University of Chicago. From that time until the end of World War II, he worked with atomic energy projects at Oak Ridge, Tenn., and the Hanford Engineer Works in the State of Washington. Since 1948 he has been a member of the Public Relations Department. For many years, Mr. du Pont has been a student of the history of the company and the du Pont family.

The home offices of E. I. du Pont de Nemours and Company are located in Wilmington, Del. The Du Pont Building in the left foreground, containing hotel, theater, and business offices, fronts on Market Street and is connected by an eighth-floor bridge with the Nemours Building, at right.



World War I expansion required training of new employees like these at the Haskell, N. J., smokeless powder plant. Employment in the company's own plants rose from 5,500 in 1914 to more than 55,000 in 1918.

in Havana placed an order for 200,000 pounds of powder. After consultation with President Polk and his cabinet it was concluded that the powder might be for Mexico, and the order was refused. Later a Frenchman named Desache and a Spanish partner sought to buy 200,000 pounds of powder for cash. Although they gave good references, Alfred suspected that the powder was intended for Mexico, and rejected the offer.

Alfred was succeeded in 1850 by his brother, Henry du Pont, a West Point graduate who, until his death in 1889, was to devote almost every waking moment to the company's affairs. Through his great energy, his thrift and economy, and his organizational ability he brought the company to the point where, in 1860, it represented one-third of the nation's powder-making capacity. The company was also fortunate in its chief chemist: Lammot du Pont, Henry's nephew and a son of Alfred Victor, was the country's leading authority on explosives chemistry.

In 1858 the du Ponts, like many other citizens of the day, sensed that the nation was moving toward civil strife. With this in mind, Lammot du Pont made a three-month visit to Europe to study the manufacture of powder and new types of guns. He returned with many new ideas, and in association with Captain Thomas J. Rodman and a Major Hagner, of the Ordnance Department, worked until the outbreak of the Civil War on improvements in munitions and ordnance.

Captain Rodman was the inventor of the "Rodman gun," provided with a hollow core through which flowed cooling water. New guns of large bore, from 15 to 20 inches, had been invented, but were impractical because the gun could not resist the pressure of the large powder charge. Captain Rodman invented a method of measuring the pressure of powder gases in the gun, thus opening the way for modifying the explosive force in the gun.

Lammot du Pont decided that by increasing the density and size of the powder grain he could obtain a powder that would burn more slowly than conventional powder. This would permit the released energy to take the line of least resistance, that of the open barrel, thus reducing peak pressure within the breech and increasing the propelling effect. Known as Mammoth powder, this new propellant was manufactured with a large round grain, sometimes three inches in diameter, under molding pressures as high as 20,000 pounds for extreme density.

MAMMOTH POWDER was used in the battle between the "Monitor" and the "Merrimac." With the iron-clad ship and the large cannon, it was a factor in revolutionizing the navies of the world.

Two days after the fall of Fort Sumter the Du Pont Company notified the State of Virginia that an order for powder would be delivered only if the state remained loyal to the Union. The company recalled its Southern agents, cancelled Southern orders, and gave its pledge of support to President Lincoln.

In May 1861, Governor William Burton commissioned Henry du Pont major general in command of all Delaware troops. Immediately every man in the company's employ was required to take the oath of allegiance to the Union. Two companies of troops were organized from Du Pont employees, primarily for protection of the mills, because secessionist sentiment was high in Delaware's two southern counties. In 1863 these troops, with other Delaware soldiers, were called upon to drive back a troop of Confederate cavalry which had advanced within fifty miles of the mills.

From the outbreak of war there was close cooperation between the company and government officials with regard to the Union's powder supply. In the fall of 1861, Lammot du Pont warned the government that England's unfriendly attitude might cut off imports of saltpeter. He was promptly sent to London to buy saltpeter. Although England laid an embargo on saltpeter after the *U.S.S. San Jacinto* forcibly removed the Confederate envoys, Slidell and Mason, from the British mail ship *Trent*, this was lifted after their release. Six vessels laden with saltpeter sailed from England in February 1862, and in the same year the government authorized the Du Pont Company to buy more saltpeter through its agents in England.

By the beginning of 1863, this supply was exhausted, and further imports from England were all but prohibitive, because the pound sterling had risen to $13. The solution was found in a chemical process which had been outlined by Irénée du Pont as early as 1831—conversion of South American sodium nitrate into potassium nitrate, which was entirely suitable for military powders.

During the Civil War, the Du Pont Company furnished between 3,500,000 and 4,000,000 pounds of powder to the government. All of it was made for the government at prices below the market price to other consumers and below the prices paid by the British government in peacetime. "There never has been a case in any country in the world," Henry du Pont wrote in 1864, "where a nation at war has had its powder so cheaply as the United States have had it since the breaking out of the Rebellion."

As in the War of 1812, the government again was financially embarrassed by war, and suppliers were kept

The Du Pont Company's Experimental Station at Wilmington, Del., as it looked in May 1951, following a $30,000,000 expansion program, making it one of the largest research laboratories in American industry.

waiting for payment. In July 1864, powder furnished in August 1863, was still unpaid for. It was not until August 1865, that all bills were paid, and even then settlement was made on a basis of 25 per cent cash and 75 per cent certificates of indebtedness. When the war was over, the government asked to be released from all outstanding contracts for powder and the Du Pont company cancelled its contracts outright without compensation.

The war caused the loss of substantial commercial business in the south and west. It brought new competition in the iron and coal fields. In California, where miners were unable to obtain eastern explosives, local interests organized the California Powder Works, which by 1865 was manufacturing 500,000 pounds of blasting powder a month. Also, from 1866 to 1872 the government sold huge stocks of surplus war powder at public auction, at prices that manufacturers could not meet.

During the 1870's Lammot du Pont continued to work on improvement of military powders. In 1872, he and Eugene du Pont patented the so-called spherohexagonal cannon powder, which was used for a time by the United States Army. In 1884, the Ordnance Department asked Du Pont to duplicate brown or cocoa prismatic powders, which had been developed in Europe. The company obtained licenses from a German manufacturer, and Eugene du Pont obtained patents in 1886 and 1887 for improvements on this type of powder.

In 1889, Alfred I. du Pont, then 25 years old, was sent to France to attempt to buy the formula of the French Poudre B, first of the smokeless powders. Although he failed to get any information from the French, he did purchase a smokeless powder formula from the Belgian firm of Coopal et Cie. Francis G. du Pont and Pierre S. du Pont then went to work on smokeless powder. The company delivered its first guncotton to the Navy in 1892, and in 1893 Francis and Pierre du Pont reported that they had compounded a smokeless powder. It was, however, a sporting powder, not suitable for military use.

Du Pont continued to work towards a military smokeless powder. On the eve of the Spanish-American War, it had manufactured smokeless powder that was satisfactory for small arms, and had done much experimental work with smokeless cannon powder.

When war came in April 1898, the government's magazines were all but empty. War had seemed remote, and the government had been reluctant to stock brown prismatic powder when it appeared that smokeless powder soon would make it obsolete. Since it took as long as six months to dry smokeless powder, the government was compelled to fall back on brown prismatic powder.

The government asked Du Pont to increase it capacity for this powder from 3,000 to 25,000 pounds a day, and to supply 5,000,000 pounds with utmost dispatch. Within 60 days of the order, the company was producing 25,000 pounds a day, and within four months had delivered 2,200,000 pounds. Then the war ended. The Chief of the Navy's Bureau of Ordnance asked the company to cancel its outstanding orders and substitute smokeless powder "at a price which will compensate you for the expense to which you have been put in increasing your output of brown prismatic."

Eugene du Pont, who had become head of the company

(Continued on page 45)

Savannah River Project, which Du Pont designed, built, and operates for the Atomic Energy Commission, required laying of 85 miles of sewer and water pipe. Nearly 40,000,000 cubic yards of earth were excavated, equivalent to a wall six feet high and ten feet broad, extending from Atlanta, Ga., to Portland, Ore.

The Gold Seekers:

An Outline of the Ancient Art of Alchemy

△ △ △

By WYNDHAM MILES
Chemical Corps Historical Office

IN 1941 WHEN R. Sherr, K. T. Bainbridge and H. H. Anderson of Harvard University bombarded mercury with fast neutrons and obtained gold,* they, in a sense, reached the end of the rainbow that the alchemists had been chasing for two thousand years. We do not know who first conceived the idea of transmuting base metals into gold, but the idea, once raised, persisted through the centuries and followed the advancing front of learning through the East and into Europe. Not until the 18th century when a slowly accumulated, overwhelming mass of scientific evidence proved that transmutation was impossible by ordinary chemical methods did men give up the search. And not until the 20th century when atomic science developed did men find it possible to "make" gold by any means.

The First Western Alchemists

The earliest Western alchemists lived in the Greek-speaking part of the ancient world at the high tide of Greek science. They wrote in Greek, but the literary style of their writings indicates that they were Egyptains or Hebrews. Their original writings have disappeared, and the only record that we have of their experiments exists in manuscripts which date from about 1000 A.D.

Strange as was their aim, these men had a theory quite reasonable at their stage of learning, which indicated the possibility of transmutation. The Grecian philosophers had developed an idea that there was only one ultimate kind of matter. This matter could exist in different forms. To illustrate, gold, silver and lead were composed of the same matter, but in different forms. The problem of the alchemist was to change the form of lead or copper into the form of gold. In the hands of later Arabic and European alchemists this theory became more sophisticated, but it always pointed to the possibility of transmutation.

We do not know as much as we would like about the work and ideas of the early alchemists. Part of our ignorance stems from a dearth of manuscripts and part is due to the intentional and unintentional obscurity of the texts. The unintentional obscurity was caused by the lack of a precise, scientific terminology. In the absence of scientific words the writers had to use similies, analogies, or imaginative descriptions to express their procedure and results. On the other hand the intentional vagueness of other manuscripts came from the author's desire to appear successful, to obtain prestige, or to hide secrets from the layman. A passage from *The Dialogue of Cleopatra and the Philosophers*, one of the earliest alchemical writings, dating probably from the second century A.D., illustrates the difficulty of interpretation:

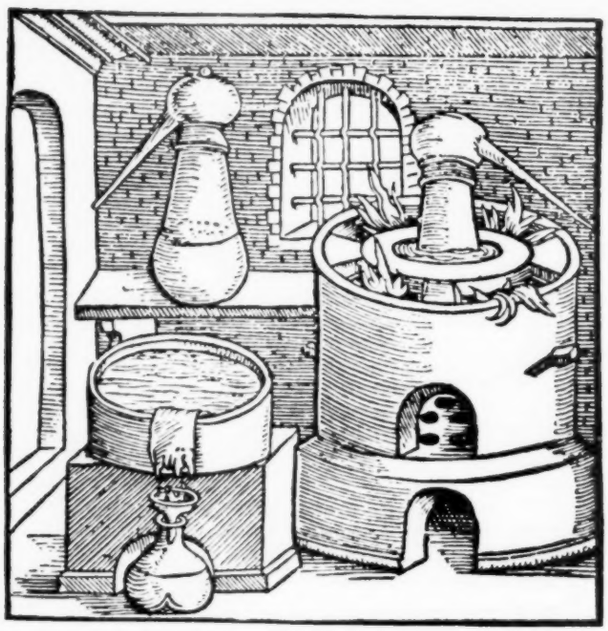
> **For I tell this to you who are wise: when you take plants, elements, and stones from their places, they appear to you to be mature. But they are not mature until the fire has tested them. When they are clothed in the glory from the fire and the shining color thereof, then rather will appear their hidden glory, their sought-for beauty, being transformed to the divine state of fusion. For they are nourished in the fire and the embryo grows little by little nourished in its mother's womb, and when the appointed month approaches is not restrained from issuing forth. Such is the procedure of this worthy art. The waves and surges one after another in Hades wound them in the tomb where they lie. When the tomb is opened they issue from Hades as the babe from the womb.**

* In an article, "Transmutation of Mercury by Fast Neutrons," in *Physical Review* 60, 473-479 (1941) these investigators tell of the formation of three radioactive gold isotopes in an experiment using a Cyclotron.

DR. WYNDHAM MILES

Dr. Wyndham Miles, chemist and historian, has been with the Historical Office, Office of the Chief Chemical Officer, since 1953. He has the degrees of B.S. in chemistry, M.S. in organic chemistry from Pennsylvania State University and Ph.D. in History of Science from Harvard. Dr. Miles has been employed as an industrial chemist and as a teacher of chemistry in college. He is the author of many articles dealing with the history of chemistry, including "Chemistry Confronts The Continentals," an account of the production of gunpowder by the American Colonies in the Revolutionary War, which was published in the Armed Forces Chemical Journal, July-August 1954 issue. He has also presented numerous papers on the history of chemistry before the American Chemical Society.

The frontispiece of a famous alchemical work, the *Basilica Chymica* (Frankfort, 1609) of Oswald Croll.



The process of distillation as illustrated in an English edition of *The Works of Geber* (1678).

The author was describing some sort of an alchemical operation, but his manner of expression is so fanciful that we cannot tell what materials he used or what he did with them. This obscurity is not confined to the early manuscripts; it is common to alchemical writings of all ages, and makes the understanding of books difficult, sometimes impossible.

In their workplaces the alchemists took minerals, metals, and animal and vegetable substances and submitted them to many kinds of operations. They were not able to make gold, but during the course of their crude, fumbling experiments they developed vessels which, over the centuries, evolved into the apparatus used by the early chemists. Almost eighty different kinds of apparatus, including furnaces, water baths, crucibles, beakers, flasks, phials, mortars, pestles, filters, strainers, stills, sublimatories and stirring rods, appeared for the first time as laboratory equipment in the Greek alchemical writings. This was their important contribution to practical science.

Oriental Alchemy

A few centuries before alchemy appeared in the Mediterranean civilization it arose independently in China. The aim of the oriental alchemists differed from that of their later, western brethren; they sought an artificial gold from which they could prepare the elixir of life, which would restore health, bring back youth, and bestow immortality. They did not seek gold for wealth.

The earliest records of alchemy in China date from the fourth century, B.C. The texts are esoteric and frequently undecipherable. Substances were given allegorical names such as Scarlet Bird, White Tiger, and Grey Dragon, which lends an air of mystery but makes the discovery of their identities practically impossible. Among the operation used during the experiments were sublimation, fusion and perhaps distillation.

The almost simultaneous rise of alchemy in the East and West is certainly remarkable, but the different purpose of the two groups of men seem to rule out the possibility that Western alchemy was derived from the Eastern. It was not until many centuries later, when the Arabic civilization became dominant in the West, that the Chinese idea of the elixir of life passed across Asia and into the Mediterranean Basin and was incorporated into the ideas of the Islamic scientists.

The Alchemists of Islam

The religious teachings of Mohammed in the seventh century welded together the Arabic states and wandering tribes into a great union which, by the tenth century was the leading power from Spain in the West to the borders of India in the East. The Arabs were at first hostile to infidel learning, but in the eighth century their attitude changed and they became patrons of science and the arts. They translated and studied the early Greek writings, and thus became acquainted with alchemy. For the next four centuries men in the Arabic countries were the chief practitioners of the alchemical art.

We have a greater knowledge of the work of the Arabic alchemists than of their predecessors, although the history of Arabic science has, on the whole, been rather neglected. At first the Arabs followed the earlier Greek writings, but after exhausting the information contained therein they initiated their own experiments. The theories which became their guides and which they raised to prominence were the concept of the four elements and the sulfur-mercury formation of metals. The idea of the four elements stemmed from the Greek philosophers. There was thought to be four fundamental forms of matter. These were earth, fire, air and water. This idea

Symbols used by the alchemists. From Oswald Croll's *Basilica Chymica* (1609).

was based on such observations as the burning of wood which gave off flames (i.e., fire) and left behind a residue of ashes (i.e., earth). Each of the so-called elements had two properties: earth was dry and cold, fire was dry and hot, water was moist and cold, and air was moist and hot. To transmute one element into another, it was necessary to alter the proportions of heat, cold, dryness and mois-

ture in the composition. This could be done by preparing pure "cold," "dry," "hot" and "moist," and using them as reagents. Methods of preparing these "substances" were worked out, on paper, by the Arabs. The famous alchemist Abu Musa Jabir B. Hayyan, more popularly known as Geber, who lived at Kufa around the end of the eighth century, wrote that pure "cold" could be produced by adding a moisture-absorbing substance to water, distilling the mixture, and then repeating the operation seven hundred times, whereupon all the moisture in the water would be removed, leaving behind a residue of pure, white, crystalline "cold." This "cold," when added to metal, would change its composition, causing transmutation. Later European alchemists were attracted to the four-element theory, and spent much of their time attempting to alter the composition of metals.

The other theory which the Arabs favored, and which was derived ultimately from Greek sources, postulated the formation of metals from two hypothetical substances called "mercury" and "sulfur." These two substances were present in the core of the earth. A dry vapor from "sulfur" and a watery vapor from "mercury" filtered upward through the rocks and, uniting in various proportions, formed different minerals. Gold had the most "mercury" and the least "sulfur" in its composition. To prepare gold, it was necessary to remove "sulfur" from the base metals.

This frontispiece from an early German edition of the works of Paracelsus is an excellent example of the allegorical illustrations found in books on alchemy. The figure on the left, crowned with the sun, represents gold. The figures on the right are Mars (iron), Luna (silver), Jupiter (tin) and Venus (copper). The winged figure in the clouds is Mercury.

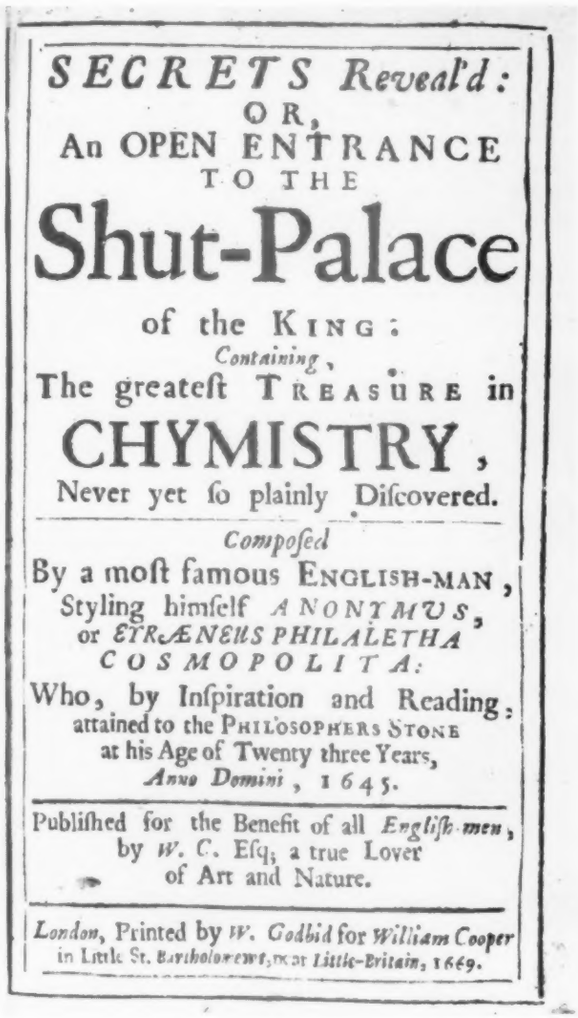
The alchemists of Islam wasted much of their time in futile attempts at transmutation, but during their experiments they discovered new substances, reactions and facts, all of which were useful to the chemist who came along centuries later. They brought into prominence ammonia, sal ammoniac, borax and other compounds. Through their writings the western world first became acquainted with the mineral acids. Geber's recipe for the substance which we call nitric acid was this: heat to redness in an alembic a mixture of one pound of vitriol of Cyprus (copper sulfate), two pounds of saltpetre, and one-half pound of alum of Yeman (aluminum sulfate). This process was used for several centuries in Europe.

In addition to discovering chemical facts the Arabs advanced the design of laboratory apparatus. The drawings of equipment which they placed in manuscripts and which later appeared in printed books helped the early alchemists of Europe to learn the practical side of the art.

Alchemy Reaches Europe

The crusades of the 11th, 12th and 13th centuries awakened Europe and quickened the pace of civilization. Educated men became interested in Grecian philosophy and science. Arabic manuscripts bearing the learning of the ancients were translated into Latin. In 1144 a scholar known as Robert of Chester drew up the earliest known European alchemical manuscript. Thereafter alchemical writings appeared with increasing frequency. The invention of movable type in the middle of the 15th century and the subsequent rise of the book trade made alchemical tracts readily available. The followers of alchemy increased, and in the next two hundred years the pseudo science reached the peak of its popularity. During this

(Continued on page 38)



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OR,
An OPEN ENTRANCE
TO THE
Shut-Palace
of the KING:
Containing,
The greateſt TREASURE in
CHYMISTRY,
Never yet ſo plainly Diſcovered.
Compoſed
By a moſt famous ENGLISH-MAN,
Styling himſelf *ANONYMUS,*
or *EIRÆNEUS PHILALETHA*
COSMOPOLITA:
Who, by Inſpiration and Reading,
attained to the PHILOSOPHERS STONE
at his Age of Twenty three Years,
Anno Domini, 1645.
Publiſhed for the Benefit of all *Engliſh-men*,
by *W. C.* Eſq; a true Lover
of Art and Nature.
London, Printed by *W. Godbid* for *William Cooper*
in Little St. Bartholomews, near *Little-Britain*, 1669.

This alchemical work has been attributed to George Starkey who learned alchemy in Boston and later became a famous physician in London.

ELIMINATION OF NONESSENTIAL REPAIR PARTS

By

STEWART R. VICKERY
Chemical Corps Engineering Command

and

MARVIN P. BATTS
Chemical Supply Section
Memphis General Depot

BY DEFINITION a repair part is that essential element, material, component, assembly, or sub-assembly of an item of equipment required for the maintenance or repair of that equipment.

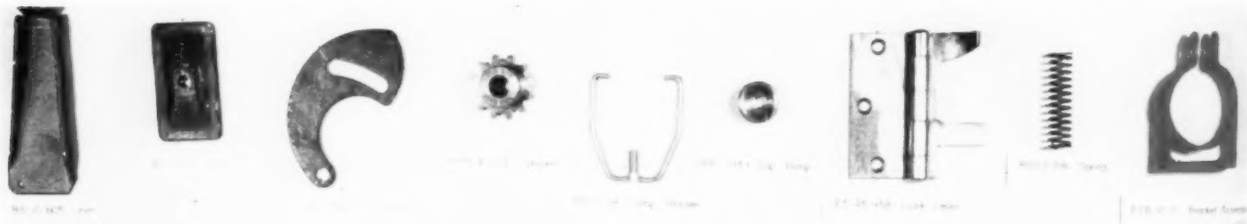
Basically every item contained in Bills of Material drawings for any given equipment is a potential repair part; however, one can readily visualize the enormous expense and complications incurred in providing facilities and making provisions for such a condition. Furthermore, it is not difficult to recognize that management of a repair parts system in such a fashion would be highly impracticable and from every conceivable viewpoint would result in a most inefficient and extremely costly operation. Consequently, based on engineering estimates, issue experience data, maintenance evaluation, and other relevant factors, repair parts are born into the supply system for the express purpose of accomplishing the optimum of maintenance and repair with a minimum of expenditures and labor. Those responsible for determining whether a certain item should be introduced into the supply system as a repair part must have a clear understanding of the intended use of the equipment in question and the principles involved in its construction and operation.

The factors to be considered in the development of repair parts lists should include, but not necessarily be limited to, the following:

1. Mortality (consumption) rates for individual items.
2. Emphasis to be placed on allowances of fast moving parts.
3. Drastic limitations or elimination of nonfunctional or slow moving parts.
4. Requirements for mobility.
5. Technical skill required.
6. Limitations of infrequently-required, bulky or very heavy parts, requiring time or use of facilities not available to lower echelons of maintenance.

Despite the fact that the utmost of precaution and care is exercised in determining whether or not a particular component shall be established as an authorized repair part, it is conceivable that in some scattered areas the

Typical examples of the elimination of nonessential and duplicate repair parts. A total quantity of 798 items were determined to be either nonfunctional, maintenance free for the life expectancy of the end item, or luxury type items and accordingly were deleted from the supply system as being nonessential for effective maintenance requirements. Standardization on similar and duplicate items resulted in a reduction of 104 items from the supply system. The name repair part has now superseded spare part in military supply terminology.



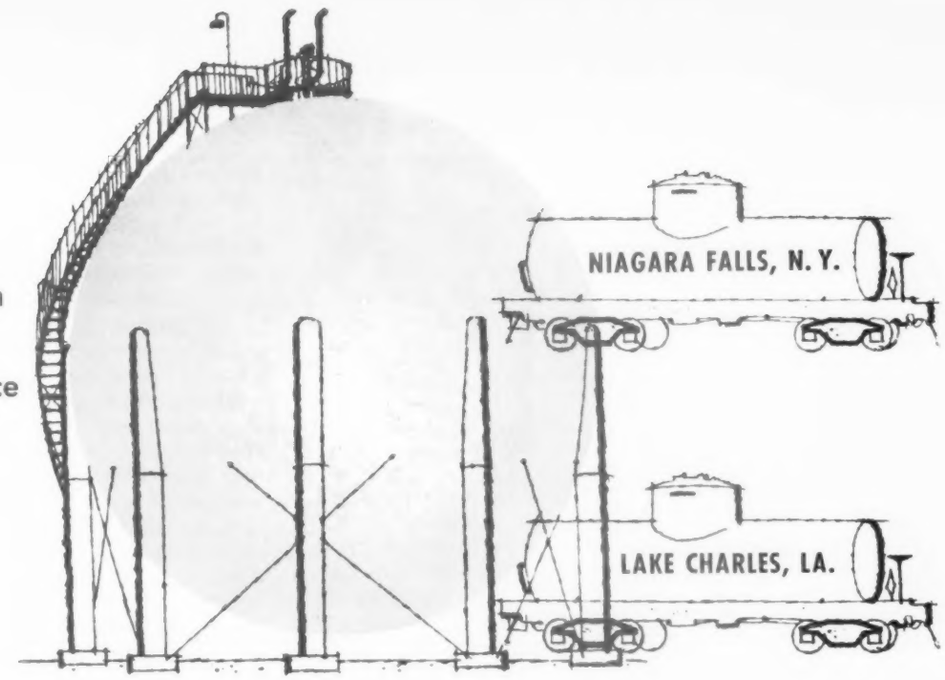
ELIMINATION OF NON-ESSENTIAL SPARE PARTS

ELIMINATION OF DUPLICATE SPARE PARTS

multi-plant production

skilled technical service

traditional quality



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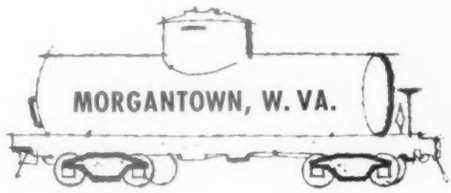

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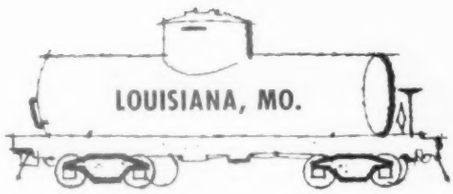

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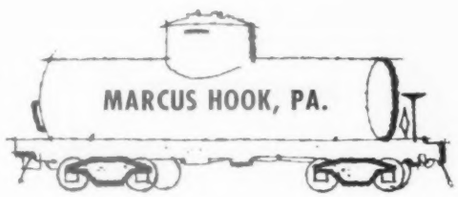

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INORGANIC CHEMICALS: Ammonia • Bicarbonate of Soda • Carbon Dioxide • Caustic Potash • Caustic Soda • Chlorine • Hydrazine and Derivatives Hypochlorite Products • Nitrate of Soda • Nitric Acid • Soda Ash • Sodium Chlorite Products • Sulphate of Alumina • Sulphur (Processed) • Sulphuric Acid
ORGANIC CHEMICALS: Ethylene Oxide • Ethylene Glycols • Polyethylene Glycols • Glycol Ether Solvents • Ethylene Dichloride • Dichloroethylether Formaldehyde • Methanol • Sodium Methylate • Hexamine • Ethylene Diamine • Polyamines • Ethanolamines • Trichlorophenol • Trichlorobenzene

selected item may be procured, packaged, and stored, but may actually never be required for issue due to no maintenance requirement developing. Immediately after such a situation becomes known, appropriate action is initiated to delete that item as an authorized repair part and to prevent any recurrence of it being designated for replacement purposes.

Survey to "Purify" the Program

Through no particular lack of competence on the part of any activity and due to changes from time to time of logistic policies, a cumulation of the foregoing instance had resulted in the supply system being cluttered up with a multitude of nonessential items, slow moving parts, etc. Recognizing the critical need for a complete review of repair parts, the Chemical Corps Engineering Command, in conjunction with the Chemical Section, Memphis General Depot, Materiel Command, has completed a program to remedy the existing repair parts discrepancies and has implemented the necessary measures to prevent the recurrence of a similar condition.

This special project was initiated in September of 1954 to review all repair parts in the supply system from the viewpoint of "purifying" the entire overall repair parts authorization program. Primarily, the project revolved around the examination of individual and assembly type parts to eliminate those items considered to be nonessential, to incorporate individual items with relative application and calculated life expectancy into repair parts kits, to delete those type parts that may be fabricated in the field, and to standardize on commercial pack and unit of measure. The approach to the repair parts evaluation was actually to conduct a physical examination of every authorized repair part along with the review of corresponding Supply Manuals, Chemical Corps drawings, and affected specifications. This method afforded the project-reviewing representatives a thorough acquaintance with the part and enabled them to identify those items suspected as being excessive to maintenance requirements. The "suspicious" items were then further reviewed by technical personnel for final decision on the action to be taken and a firm decision was made "on the spot" in regard to final disposition of the original review proposals. This method of executing the program greatly contributed to an early accomplishment of the project in that valuable time was not lost in the preparation of formal reports with recommendations which would have to be acted on by a number of activities at some later date.

In the performance of the parts review it was found that a considerable quantity of apparently different commercial components were, in reality, duplications listed under various manufacturers and manufacturers' part numbers. Also there were functionally identical commercial type parts in which there was a slight variation only in the assembly or attachment design. These originally necessitated the assignment of independent descriptions and stock numbers for Chemical Corps applications. By incorporating minor design modifications into the mating or attaching assemblies, a number of individual components and/or sub-assemblies were standardized into one common item satisfying all previous design requirements, and resulting in a reduction of the variety, kind, and type of commercial parts procured, stored, and issued in the supply system.

During the initial planning stages of the program, designed to evaluate the repair parts system with a critical eye toward reducing the mass inventory of nonessential items, the objectives were reviewed. The areas of (1) nonessential repair parts, (2) diversity of repair parts, (3) interchangeable parts, (4) unnecessary variants, (5) duplication, (6) standardization, and (7) repair parts kits, were determined to be of paramount consideration in accomplishing successfully the intent of the program.

Discussion of Factors Involved

In the order listed above, the factors of consideration are discussed below:

1. ***Nonessential Repair Parts.*** In the supply and maintenance operations of any system, the first thought that comes to mind is "What are the determining factors in classifying this item or that item as either 'essential' or 'nonessential'?" Certainly, one would desire to have made available to him that particular part which is required to satisfy his special need at any given time, but an attempt to justify each and every individual, anticipated requirement would necessitate the procurement and storage of an endless variety and quantity of repair parts. In other words, a component part for a piece of equipment may very well be considered as essential by one user and be considered as nonessential by another user, depending on the protection and care given that equipment by each user during normal operation. But, through the compilation of usage data and operating experience from a cross-section of all users of a particular piece of equipment, a list of those parts reflecting a reasonable degree of consistent issue combined with a technical analysis of the replacement requirement constitutes an item considered to be essential for normal and/or anticipated operating conditions. All other component parts, including those of a slow-moving nature, and those which are not indispensable for the effective operation of the equipment involved are categorized as nonessential.

In the recent review and examination of the Chemical Corps supply system approximately twenty percent (20%) of the existing authorized repair parts were reclassified as being nonessential. This resulted in action being immediately initiated to make proper disposition of these parts and to discontinue current and projected procurement of them.

2. ***Diversity of Repair Parts.*** The magnitude of the repair parts problems, particularly in regard to dissimilar or unlike component parts, is not a new problem in the Army supply system, but, in fact, dates back to World War I. In that war the maintenance support policy was based on the concept that each and every part was subject to failure and therefore every part for every item should be stocked for replacement purposes. During the period between the two world wars, manufacturers and government agencies made some progress in designing and producing standard parts and common hardware. Common threads, uniform bore sizes, and uniform bore strokes for gasoline engines were adopted. During the mobilization for World War II, the World War I concepts of reliance on the manufacturers for repair parts support and the stockage of every part were abandoned.

The policy in vogue upon entering World War II was that only essential repair parts would be stocked by the Army. However, the wide range of end items in use resulted in many different types of repair parts entering into the system; another reason for a wide variety of parts is the large number of different makes and models of essentially similar equipment.

3. ***Interchangeable Parts.*** Generally speaking, the term "interchangeable parts" refers to identical items made by one or more manufacturers. However, as often used in supply procedures, the reference applies to parts which serve the same purpose but which may not be identical in shape or design. For example, items such as distributors, fuel pumps, carburetors, etc., made by several manufacturers may, despite slight differences in shape, design, or fabrication, be used in the same application and are therefore considered to be interchangeable one with the other. Parts are sometimes fully interchangeable two ways and often times only interchange-

able one way. To illustrate, an all-weather (cold resistant) "O" ring for the flame thrower may be used for a like size ordinary "O" ring on the hopper assembly for the mixing and transfer unit, but the "O" ring for the mixing and transfer unit hopper assembly (not all-weather) is not suitable for use on the flame thrower. Therefore, the flame thrower "O" ring is a two-way interchangeable item while the mixing and transfer unit "O" ring is a one-way interchangeable item.

The question now is whether it is more economical to furnish the flame thrower "O" ring for both applications or to furnish separate "O" rings for their respective uses. Solutions to this type problem depend on the merits of each individual case.

4. ***Prevention of Unnecessary Variants.*** It is impossible to establish firm rules applying to every conceivable variation among items of supply, since the variations may range from virtually indistinguishable differences in appearance to major differences in both appearance and use. Standard specifications designed to prevent variants from entering the supply system are established wherever possible, particularly to commercial type items. However, if the standard specifications are too "tight," there will be a tendency to increase the procurement and stocking of variants. It is important that the specifications contain all commercial products capable of satisfying the essential end use. Mere convenience, however, is not a criterion in stipulating additional characteristics for a given product if the presence or absence of the added characteristic is immaterial to the intended use of the product.

Despite efforts to prevent variants from entering the supply system, the inability to procure the standard item oftentimes results in the stockage of two or more variations of a single item. In cases such as this, by merging the items and giving priority issue to the variant, the variants can be removed from the system.

5. ***Duplication of Items.*** Duplicate items are frequently hidden in the supply system behind different manufacturers and manufacturers' part numbers. Instances of this kind are sometimes unavoidable and quite difficult to rectify. As a typical example, consider the M1A1 Compressor wherein two major groups of repair parts are the gasoline engine and the compressor. The Army supply system may, and probably does, already have on hand compressors assembled by other manufacturers together with supporting repair parts. Or, even though there may be no other compressors in stock, there would be all kinds of small gasoline engines presently being maintained. To maintain these engines there would be on hand about every size, type, and kind of bolt, nut, washer, cotter pin, spark plug, carburetor, piston rings, and bearings. Except for a few parts actually manufactured by the compressor manufacturer himself, possibly every single part required to maintain the compressor is already in the supply system. If these parts already in the system are procured and stocked according to the compressor manufacturer's part numbers, the repair parts inventory will be duplicated with all the attendant excess costs.

Unless the compressor manufacturer makes special efforts to provide the cataloger with all the relevant information about the source and precise identity of his repair part, the required identification data must either be obtained from him or laboriously researched for each and every compressor part against parts already in the system.

The joint review of repair parts by actual physical examination has corrected duplications of this sort in the Chemical Corps.

(Continued on page 44)

"A CASE OF IDENTITY"

Colonel S. J. M. Auld, president of the Institute of Petroleum, with offices at 25 Victoria Street, London, S. W. 1, England, has written the JOURNAL a very gracious letter calling attention to an error in our September-October 1955 issue listing him as one (No. 51) of the group of scientists, Army, and Navy officers pictured on page 20 under the title, "Gas Warfare Research Group—1917."

Colonel Auld, a retired British Army officer, received the copy of the JOURNAL through the kindness of Mr. Norman Thompson of the Sun Oil Company. Colonel Auld states in his letter that the group photograph appears to have been taken before he arrived in the United States with the British Military Mission in World War I. He became identified with the chemical warfare establishment here and later returned to France with the 30th U. S. Engineers and served in the Argonne with that regiment. The unit was subsequently designated the First Gas Regiment.

The JOURNAL is pleased to print herewith an authentic photograph of Colonel Auld.

The principal purpose of printing the photograph of the 1917 group together with the partial list of identifications was to obtain verifications of the list for Mr. A. Fieldner, chief fuel technologist of the Bureau of Mines, who was himself one of the 1917 scientific group.

The complexity of today's weapons systems—in being or projected—and the urge for further "break-throughs" in science, place ever-increasing demands upon organic chemistry for materials of hitherto undreamed of properties. In this article, Mr. Hooker discusses the vital importance to our national defense of the organic chemical industry of this country, and develops his view that its continued well-being depends essentially upon its protection by 'selective security tariffs.'"

In recognition of the fact that the tariff question is one on which there are widely different opinions, the Journal notes that the publication of this article is not to be construed as indicating necessarily an indorsement by A.F.C.A. of the tariff policy described.—Editor.

TARIFFS AND TECHNOLOGY

By R. W. Hooker

President, Synthetic Organic Chemical Manufacturers Association

The readers of the Armed Forces Chemical Journal need no introduction to the key importance of chemical research to our nation's technological and, hence, military strength. Few of us, however, have the chance to think about the kind of action that is needed on a national scale to keep technology growing at the clip necessary for U.S. world leadership.

A number of people *have* been thinking about these matters. What they have found and what needs to be done rate the attention of every scientist and executive in the chemical industry.

Very recently the Secretary of the Army approved the report of the Advisory Committee on Chemical Corps Mission. The Committee's report reminds us that "Encouragement and effective utilization of the nation's technology is a decisive factor in national defense. In all fields of scientific and technical endeavor—whether nuclear, aerodynamic, chemical, biological, electronic, mechanical, etc.—the nation's defense needs call for the finest effort and the best result of which man is capable. Pre-eminence is essential both for avoidance of war and for survival in warfare."

The urgent importance of technological leadership to our national security is justification enough for the American people to adopt whatever measures are needed to sustain it. But the price of these measures really makes technology a bargain when we realize that it is just as important to our national *welfare*.

The National Science Foundation has recently placed its seal of approval on this quality of technology. In a comprehensive report on scientific personnel resources, the Foundation stated that "Our expanding economy and rising standard of living require that increasing proportions of our labor force be devoted to science and technology. National science policy must make provision for the initiation and support of measures designed to assure the adequacy of our scientific and technical personnel resources to meet potential needs."

From the security standpoint there is ample evidence that the United States may be losing its position of leadership to Soviet Russia. The Commission on Human Resources and Advanced Training reported in 1954 that "Russia is increasing her supply of management experts, engineers, scientists, doctors, and other professional men and women as rapidly as is the United States, and in some fields more rapidly." The National Science Foundation reported in 1955 that "the scientific and technical personnel resources of certain other countries are rapidly approaching ours in numbers, with the indication that we may be surpassed within the next few years." In its recent study on SOVIET PROFESSIONAL MANPOWER, the Foundation reported that in applied scientific fields the number of Soviet professionals with completed higher education was about equal to or somewhat above the number of trained persons in these occupations in the United States.

If, as the Commission found, the state of the world for centuries to come may hinge largely on the effectiveness with which we in the United States employ our intellectual resources and if, as it also found, both our military security and peacetime welfare are closely tied to scientific progress—we need to look to the manpower and material resources which support our technology.

We can hardly be faulted on the growth in the number of scientists in the United States since 1930. We had 46,000 scientists in that year. By 1940 this number had grown to 92,000. In January 1954 the Office of Defense Mobilization estimated there were approximately 200,000 scientists in the United States. More than half of these were employed by private industry, according to a preliminary report of a National Science Foundation survey just published. Half of these scientists are chemists, by

ABOUT THE AUTHOR

Mr. R. Wolcott Hooker, vice president of Hooker Electrochemical Co., was elected president of the Synthetic Organic Chemical Manufacturers Association last December. He was born in Chicago, is a graduate of Cornell University, and attended the Advance Management Program at Harvard University in 1954. Mr. Hooker is also president of the Chlorine Institute, past president of the Compressed Gas Association, and is a Director-at-Large of the Armed Forces Chemical Association and a director of the National Industrial Conference Board.

far the largest group, and 60,000 of the chemists are employed by private industry. The largest portion of the chemists (39%), as you might expect, were employed in the chemical industry.

There is evidence, however, that our supply of professional and scientific manpower is not keeping abreast of the absolute current and potential requirements of the expanding technology upon which our national growth and security depend. This was the conclusion reached by the Committee on Manpower Resources for National Security in late 1953.

The August 1955 *Scientific Manpower Bulletin* of the National Science Foundation found that the current shortage of research and development scientists and engineers was largest in the aircraft, electrical equipment, petroleum, paper, food, and primary metals industries. About half the companies in the chemical industry also reported shortages of scientists and engineers but only one-fifth of them indicated that the shortages were significantly impeding or retarding their research and development program. Nevertheless, physical and organic chemists with a Ph.D. degree were reported to be in great demand as well as physical and organic chemists at all degree levels with two to ten years of experience. Some firms in the chemical industry also reported a shortage of physicists for their research programs.

The importance of the organic chemical industry to the growth of the nation's technology through research and development is shown in several ways. Among the chemists of the manufacturing industries, the organic chemists are by far the largest group. The Bureau of Labor Statistics reported in 1953 that "Most industrial applications of the science are in organic chemistry. Consequently, many more chemists specialize in this than in any other branch of the profession." About 60 per cent of the chemists in the chemical industry are in the organic field. More than half of all chemists in manufacturing are employed by the industrial organic and inorganic branches of the chemical and allied products industrial group. In 1952 these two sectors of the chemical industry employed about 40,000 chemists and engineers assisted by 18,000 technicians. Nearly 75 per cent of these were employed in the organic chemical sector of the industry.

RAYMOND EWELL of the National Science Foundation presented an interesting analysis of the role of research in economic growth in the July 18 issue of *Chemical and Engineering News*. He divides the net contributions to gross national product in 1953 into amounts attributable to research and development conducted during the period 1928 to 1953. The two largest contributions were in the introduction of new products (estimated net contribution, $15 to $30 billion) and the lowering of the cost of production of products (same estimated contribution). In the category of new products the examples he offers show that the fruits of chemical research were dominant, including synthetic drugs, fertilizers, insecticides, synthetic plastics, synthetic fibers, synthetic rubber, and synthetic detergents.

Ewell's analysis is revealing because over 55% of the chemical industry's research is devoted to the development of new products. At the same time, basic research is far from neglected. The chemical industry's use of 12% of its research budget on basic research (compared with less than 7% of the Federal Government's research and development expenditures for basic research) represents a greater portion of its research effort for this use than any industry.

The industry's trade association, the Synthetic Organic Chemical Manufacturers Association, has established an incentive to basic research in organic chemistry in the form of an annual award of $1,000 cash and a suitable gold medal to the scientist who in the judgment of the American Chemical Society makes the most significant contribution to basic research in that field.

J. E. Hobson of the Stanford Research Institute recommended in his paper at the Fourth Conference on Scientific Manpower, conducted by the American Association for the Advancement of Science in December 1954, that industry channel large sums of money directly into basic research laboratories. The chemical industry must agree with this advice because the nonprofit institutions performing research receive their greatest support from the chemical industry.

The implications of this kind of research effort to the national welfare can also be drawn from a number of sources. About a year ago the *Survey of Current Business* attributed the expansion of the chemical industry in large measure to its ever-increasing scale of research and development work. Expenditures for new plant and equipment by the chemical industry in turn kept pace with the expanding outlays for research and development. The Paley Commission found that the chemical industry had made phenomenal progress since World War I by concentrating intensively on research and development and that heavy annual investments in research and plant necessary to achieve these results yielded a constant stream of new products of such basic importance that practically every industry is now dependent on the chemical industry to a considerable degree. The Commission found that the most notable supplements to our material stream in recent years have been the new synthetics—plastics, fibers, pharmaceuticals, rubber, and the like. Within the realm of scientific activity the development of organic chemicals has been outstanding.

ANNUAL REPORTS of the U. S. Tariff Commission indicate that the synthetic organic chemical manufacturing industry is devoting more than 5 cents out of each dollar of sales to research. This is well above the national average of about 3 per cent of sales. In the fourteen-year period 1941 to 1954, the synthetic organic chemical industry more than quadrupled its employment of technically trained research workers—from 3,000 to 13,500.

The chemistry of synthetic organic materials has made available at critical moments in our national history such items as dyestuffs, medicinals, synthetic rubber, plastics, camphor, synthetic fibers, detergents, antibiotics, and agricultural chemicals. Organic chemicals met World War II needs in the form of sulfa drugs, penicillin, vitamins, disinfectants, insecticides, mildew inhibitors, antifreeze, high octane aviation gasoline, de-icer fluids, brake fluids, solvents, self-sealing gas tanks, plastic coatings, rocket fuels, smokeless powders, primary detonators, and other explosives. To these were added in the Korean emergency bullet-proof vests, rockets, napalm bombs, jet fuels, and streptomycin. The wartime atomic bomb project was staffed with the skilled personnel drawn from the chemical industry. By 1953 some 20,000 chemical company workers were employed at eight AEC installations.

Nearly 4,000 chemists and chemical engineers are employed in AEC projects. Current research in the industry is developing the use of radioactive materials for analysis and chemical reactions. New developments of chemical synthesis in the fields of acetylene derivatives, flurocarbons, hydronitrogens, silicones, epoxy resins, isocyanates, terephthalate polyesters, and metals development promise considerable excitement for the immediate future.

All of these developments add up to a situation which has the following significance: Expanding technology is vital to national security, indispensable to continued prosperity; research and development activities of private industry are a major instrument in the supply of this technology; industrial chemistry occupies an important, if not a major part, in this research and development activity; organic chemists are perhaps the most important single group of scientific personnel engaged in these private research and development activities; the great majority of organic chemists engaged in research and development activities are employed by the synthetic organic chemical industry; Governmental and industrial policy must be shaped to maintain and expand this private research and development activity.

THE EXCEPTIONAL research and development effort of the companies making up the synthetic organic chemical manufacturing industry (388 companies in 1954 spent $245 million for this purpose) shows that private chemical companies individually are determined to do their part in sustaining America's leadership in the race for technological superiority.

Without the plant, equipment, and force of skilled manpower in being, however, *to utilize existing technology* to supply the chemical materiel of industry and of war, the nation would be hopelessly vulnerable to attack by an aggressor. The Synthetic Organic Chemical Manufacturers Association has, for this reason, labored earnestly in an effort to make the Federal Government fully aware of the importance of adequate tariffs against the low-cost competition of the German, English, Swiss, Italian, and Japanese chemical industries in order to preserve the economic conditions required to maintain the amount of productive capacity needed to supply military and essential civilian items in time of emergency. The *tariff policy* which our Association has been urging upon the national Government for the benefit of the organic chemical industry we call "selective security tariffs."

The unit labor cost in the production of most organic chemicals is relatively high. The many steps involved in the synthesis of our modern organic compounds require, in all but a relatively few which are adapted to continuous processing, the closest attention of our chemists, engineers, and skilled chemical equipment operators. Our methods and our efficiency are matched by those used in the well-established chemical industries abroad, but our wages range above $2 per hour while theirs are in the order of 50 cents an hour or lower.

Without a tariff to equalize the cost advantage of foreign chemicals which stems entirely from their lower wage rates, our companies could not sell their products in the American market. Without the assistance which Congress provided specifically to foster the continued growth of our industry, we could not produce most of the organic chemicals made and sold in this country today. Or, producing them, we could not compete for sales in the American market with German, English, Swiss, Japanese, and Italian chemicals which can be laid down in this country at a half or two-thirds the domestic cost of production.

In today's battle for world supremacy in technology, selective security tariffs means realistically moderating every proposal for the reduction of tariffs in the light of its probable impact *not alone* upon the plant capacity which would be needed for full mobilization, *not alone* upon the level of employment of skilled personnel which it would affect, but above all upon its effect here today on the inclination and capacity of our domestic chemical companies to devote an exceptional portion of their sales dollars to research and development, and to plow back their earnings into new plants and equipment for the production of the new chemicals created by that effort.

OUR ASSOCIATION'S POLICY of selective security tariffs has a significance far away and beyond the confines of the organic chemical industry. The intertwining of chemical technology with the technology and manufacturing processes of almost every other American industry realistically means that the measure of our efforts is reflected in the order of progress attainable throughout American industry. Unless chemical processes make possible the development of new metals to meet the challenge of jet engines, guided missiles, and intercontinental ballistic missiles, the national security will be substantially impaired. Unless organic chemical technology sustains the continued flow of new materials which are made from the abundant raw materials of America to replace critical materials which come from beyond our shores, we cannot be assured of the broad base of material resources needed to sustain any technological superiority which we might otherwise achieve. Unless the prosperity of the organic chemical industry is maintained at a level which sustains its rate of growth (now three times that of manufacturing industries generally), our companies cannot continue to provide the attractive employment opportunities to the intellectually gifted young men and women of America on the scale needed to help make the scientific professions sufficiently attractive in our capitalist economy to outstrip the production of scientific manpower by Soviet Russia.

The scientists and executives of the chemical industry and the scientists and military leaders in the Armed Forces are among the custodians of the trust of America's technological superiority. To be faithful to that trust we must be alert to preserve the wellsprings of our technology. We must give our attention to the problem of attracting young men and women of high school age into the sciences and to encourage the continuation of their interest in those fields in college and graduate school. We must be alert to support and foster the expansion of nonprofit private research and development activities. We must use our influence in our own companies to promote a continuing high level of research with due attention to a just proportion between basic and applied research. We must speak out for the adoption and faithful application of Government policies which are indispensable to the preservation of this trust, whether it be in the field of military manpower policies for mobilization, or a policy of selective security tariffs to foster a high level of activity in those areas of our industry where such assistance is needed.

MOBILE SEA BASES

(Continued from page 15)

Third, the sea base's offensive punch would be used to stop attacks at their source—the enemy's bases—using the full advantage of our *mobile* bases against their *fixed* bases. The ace we do not mind showing is that we will know course and distance to their fixed bases in advance, while they will not know the exact whereabouts of our mobile bases.

Such a carrier task force is the application of atomic capabilities in an exacting blend of air and sea power, of carrier-based fighters relying on warning and control furnished by cruisers, of warning and anti-submarine helicopters operating from cruiser decks, of carriers poised behind cruiser-launching missile umbrellas and of all ships in turn dependent on the effective destruction of enemy forces and bases by carrier-based bombers and submarine-launched missiles. It is the logical development of sea-air power in the atomic age. This would be our primary mobile deterrent force for the age of long-range missiles. It is a force which the Navy must perfect before that age comes and which, though it would not escape unscathed, would have a most favorable exchange rate in a battle as well as the power of diverting the enemy forces from our homeland.

This future carrier force has been projected to demonstrate that the carrier has not yet reached its ultimate development as a major weapons system. Further, the principle of the mobile air base, which it exemplifies is, of necessity, experiencing a resurrection among exponents of air power.

In addition to the carrier, there will be *other* mobile deterrent forces to strengthen U. S. strategy in the age of missiles. Very long-range missiles launched from submarines and surface ships constitute one fruitful line of advance. Also promising is the long-range attack seaplane. This has an additional advantage which the carrier force lacks—seaplane forces can be widely dispersed overseas in many small, relatively inexpensive units, in areas where maintenance of other forces would be too costly. The appearance of modern U.S. seaplanes in an area thousands of miles from American soil could establish a threat to an enemy's flank and require a diversion of his defenses from other fronts.

The seaplane can soon be given the speed and altitude and load-carrying capabilities of land-based jet bombers. It can be given the ability to operate from any sheltered bay, gulf, lagoon and estuary having water depth of a few feet. It can be given the capability to land in semi-sheltered sea areas adjacent to the enemy's shore, refuel, rearm, and replenish from a waiting submarine and proceed on its mission. It need not return to the area whence it departed. With these capabilities it could deliver powerful weapons to vital targets, yet operate from a mobile base well removed from threat of heavy attack. The operating base, a seaplane tender far to the rear, can be given missile and helicopter defenses against light air and submarine attack. It can be moved frequently to foil enemy attack; no advance preparation is needed and no expensive facilities are left behind as improvements to someone else's property. Nor are the sabotage and espionage problems as great for a floating base.

With perhaps half a dozen seaplanes, a single tender, and a pair of logistic submarines, an integrated force could be provided that an enemy could not ignore. Once nuclear propulsion can be fitted to the seaplanes—and for this they appear ideally adapted—the submarines could be dispensed with and the tender base moved still farther back out of attack range.

Use of a proper seaplane force is good deployment—an essential to nuclear warfare. It permits tomorrow's Navy to attack from unpredictable directions and to dilute, divert, and divide an enemy's attacking forces.

It is therefore submitted that, first, survival of the United States requires a supplementary reserve of nuclear striking power which can be launched from mobile bases and, second, the Navy's development of weapons systems employing sea and air provides such power in natural course. It is important to note also that such naval forces can be equally effective in both nuclear war and non-nuclear war. This permits us to apply the type and degree of power appropriate to the situation and avoids the predicament of being unable to use force when necessary because the only force available is too great for the circumstances.

Whether or not we become engaged in limited wars in the future, there will be jobs to do which may not involve all-out nuclear assault on the enemy's sources of military strength. Allies must be supported, supplied, and in some cases fed, and our own raw material needs must be met. And so transports, both surface and air, must flow safely across the oceans. Perhaps tactical air support for hard-pressed allies must also be provided, without atomizing a friendly population. It is likewise conceivable that in the later phases of a nuclear war the patterns of a non-nuclear, conventional war may return.

In any event these naval striking forces have the dual capability for both types of war. Most of the existing fleet was designed for the non-nuclear, and successfully so, as the Pacific wars have shown. New construction, modernization, and modifications will continue to be adapted to the atomic. But they will retain their flexibility however the issue may be joined. Mobility makes them irreplaceable as a safety factor today; the same mobility and flexibility spell economy in a world where the exact

place and nature of the next threat cannot always be anticipated. They will be replaced only by weapons of greater mobility, speed, and range.

The United States must face up realistically to the problems and requirements of nuclear war. As a first priority, varied types of striking forces must be adequately maintained which alone can deter nuclear warfare, and which alone can be decisive in the first phase of such a war if it comes. A reasonable effort must also be devoted to home defense and to the support of our overseas commitments; even though the defensive is not decisive, the enemy cannot be left an open invitation to move unopposed.

If adequate strength is to be maintained in this critical area while supporting a reasonable civil economy, there must be a constant re-examination of both the kind and the qualities of forces. Those types of weapons which give relatively less security per man or dollar—however useful they may be for specific purposes—must be questioned and reappraised. While the possible requirements of limited war must not be neglected, the maintenance in peacetime of forces which in unlimited war could be useful only in the later stages, and might even be serious burdens in the early stages, must likewise be questioned. It must be appreciated that in nuclear war it takes far fewer men to destroy at unheard of rates, and that it will take more and more men for reconstruction of industry, transport, and essential shelter.

As the nature of war changes many of our present weapons and forces will inevitably become relics of history, including elements of the Navy and of naval aviation as well. All weapons systems must stand the tests of mobility, multi-purpose flexibility, speed and range, lethality, and the other attributes. Our obligation is to discard those which do not measure up and to accelerate the development of those which show promise.

With this approach, the Navy has a future more vital and more demanding than ever before.

RESERVE ACT

(Continued from page 19)

exceptions) likewise transferred to the Ready Reserve upon completion of their active duty for training but are required to take part actively in reserve training. The law also provides effective measures to make sure that they do so.

Upon being assigned to a unit of the Ready Reserve, the reservist is required to attend a minimum of 90 per cent of the scheduled drills or training periods of the unit *and* to serve not more than 17 days active duty for training annually*; *or* he may be required to perform not more than 30 days of active duty for training each year if authorized by the Department of the Army.

Men who entered the Armed Forces or any component thereof before passage of the new Act do not automatically incur a training requirement. All such men, however, continue to be subject to the 8-year military obligation which was in effect when they entered the service.

Insuring Participation

Several incentives are offered to encourage active participation in reserve training. These include drill pay, promotion, and retirement benefits. In addition to these positive incentives, certain enforcement measures are provided to deal with the relatively few who might otherwise neglect or refuse to comply with their obligations.

Men with a training obligation in the Ready Reserve who fail to take part satisfactorily in reserve training may be ordered to active duty for training immediately, for a period of 45 days. Anyone who fails to obey such an order is subject to the Uniform Code of Military Justice. Disciplinary action, which may include a court-martial, is authorized in such cases.

Men who, under a special enlistment program, complete six months of active duty for training and then fail to take part in Ready Reserve training may initially be ordered to active duty for training for 45 days. Those who fail to obey the order, or who complete the 45 days of active duty for training and again fail to take reserve training, may be court-martialed or be reported to their local Selective Service boards for immediate induction into the Active Army.

Members of the National Guard do not come under the above provisions, since they are in a State rather than a Federal status. Disciplinary action for members of the National Guard who fail to participate satisfactorily in the required training program is provided for in the military codes of the respective States; also, a member of the National Guard who is deferred from induction by virtue of such membership and who fails to participate satisfactorily in the required training program will be reported to his local Selective Service Board for priority induction.**

Enlistment Programs

The new law authorizes additional enlistment programs under several of which a man can enlist directly into a Reserve unit. The various enlistment choices offered are among the important features of the new law:

Six Year Enlistment. Men who have not been ordered to report for induction may enlist in the Reserve for a total of six years, to be served as follows:

1. Active duty for two years or more.
2. Training in the Ready Reserve satisfactorily for a period which, when added to active duty time, totals five years.
3. The remainder of the six-year enlistment to be served in the Standby Reserve.

Eight Year Enlistment. Until 1 August 1959, men can enlist directly into a unit of the Ready Reserve. Enlistments under this program will be limited to about 100 thousand men per year for the Army Reserve.

Under this plan men are initially ordered to active duty for training for six months. They then complete the remainder of their eight-year enlistment by training with the Ready Reserve.

To be eligible for this type of enlistment a man must be physically and mentally qualified for Army service, not be under orders for induction, and be between the ages of 17 and 18½ years.

Men volunteering under this plan are given draft deferment. After finishing six months of active duty for training, they will not be inducted into the Army provided they continue to take part satisfactorily in reserve training.

Those who serve satisfactorily for eight years complete their military obligation and are no longer subject to induction or active service except after a declaration of war or national emergency by Congress. Those who do not serve satisfactorily lose their deferred status and are reported for induction into the Armed Forces.

National Guard Enlistment. The Universal Military Training and Service Act of 1951, as amended, provides for the deferment from induction of young men who enlist

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* NOTE—Under the provisions of the National Defense Act of 1916, as amended, members of the National Guard and Air National Guard are required to participate in a minimum of 48 drills and 15 days of field training annually. They may not take 30 days of active duty for training in lieu of that requirement.

** The Department of Defense announced on January 26, 1956, that commencing February 1956, National Guard enlistees entering this program will serve in Federal status during the six months active duty for training.—Ed.

in tne National Guard between the ages of 17 to 18½ years, who continue to be members and participate satisfactorily in required training until they reach age 28. The Reserve Forces Act of 1955 makes it possible for these young men to reduce their military service obligation to a total of eight years by volunteering for and completing six consecutive months of active duty for training.

One Year Assignment to a Unit of the Ready Reserve. Assignment is available to men who are subject to the eight-year obligation under the old law. Men who are to be released from the Army *before 1 July 1957*, and who volunteer to serve actively in an organized unit of the Ready Reserve for *one year* can become eligible for transfer, at their request, to the Standby Reserve.

By enlisting and serving actively in a unit of the Ready Reserve for one year, the soldier reduces the amount of time he might otherwise be required to stay in that category. Thus he reduces the likelihood of his being ordered to active duty.

Pre-Release Provision

The Reserve Forces Act of 1955 also permits the Army, at its discretion, to release men from active duty before they complete their normal two-year tour. To qualify for such release a man must have served a minimum of one year of active duty, and must volunteer to take part in Ready Reserve training for a period which, when added to his active duty time, totals four years. *The Army does not plan to use this feature of the law at this time*, because of its cost and impact on the Active Army. It has been found that technical skills can only be developed by several years of active duty, and men who serve their entire active duty tour are better trained and eventually more valuable to the Reserve.

Special Provisions

Besides providing several different ways of fulfilling the prescribed military obligation, the Act includes specific provisions to enable the young man to serve his country in a training program that best suits his circumstances.

For example, high school students who wish to enter an eight-year program will not be ordered to six months active duty for training until they graduate, cease to pursue the high school course satisfactorily, or reach age 20, whichever occurs first.

Another special provision concerns men who have critical civilian skills. To shorten the period of absence from their jobs, these men may fulfill their military obligation by taking six months of active duty for training. Then they are excused from reserve training, but continue to have a Reserve obligation.

Six-Months Trainee Benefits

Men who enter the six months active duty for training program are *not* considered to be members of the Active Army. Consequently, those choosing this program are eligible only for some of the benefits that are normally available to members of the Active Army. For example, six-months trainees are entitled to free insurance under the Servicemen's Indemnity Act of 1951 while on active duty for training. They are eligible for some death and disability benefits for injury or disease suffered while on active duty for training. They have similar re-employment rights as soldiers serving under the UMT&S Act.

On the other hand, six-months trainees do *not* receive mustering-out pay. They do *not* have veterans' preference when applying for positions under Civil Service. They are *not* eligible for National Service Life Insurance.

Accomplishments

The far-sighted provisions of the Reserve Forces Act of 1955 clear the way for a Reserve program of ever increasing effectiveness. In its immediate impact, the accomplishments are four-fold:

1) It permits an increase in Reserve strength.
2) It authorizes programs which provide trained personnel for the reserve components.
3) It establishes a definite Reserve obligation backed up by enforcement measures, and
4) It provides for direct enlistment into reserve forces.

In the long run, however, every citizen and Army member—Regular and Reserve—holds the key to its final success. Combat skill is a perishable commodity which must be constantly renewed—by a consistent, long-range program of training, by instilling in America's youth an awareness of their obligations for defense as they attain the age of responsible citizenship. The Reserve Forces Act represents an important forward stride in this direction; it creates the climate and conditions under which all energies may be directed toward building the Nation's strength in Reserve.

COLONEL GEORGE J. B. FISHER

Colonel George J. B. Fisher, 63, former Chemical Warfare Service Officer and later consultant on historical matters for the Office of the Chief Chemical Officer, died on January 11 at Fort Myers, Florida. With 30 years' active service in the Regular Army, Colonel Fisher retired as Commanding Officer of the New York Chemical Procurement District in 1947. He served in both World War I and World War II and was author of a book, *Incendiary Warfare*. During the summer of 1916 he served on the Mexican Border as a member of the New Jersey National Guard.

In World War II Colonel Fisher was in charge of all civilian defense schools set up by the Army throughout the United States and received high commendation for that duty. In order to provide for expansion of chemical warfare training facilities for military personnel Colonel Fisher was assigned to establish the Western Chemical Warfare School at the Rocky Mountain Arsenal in Denver. He was made the Commandant of the School in 1945. For his services during this assignment he received the Legion of Merit; he was also awarded the Victory Medal and the Army Commendation Ribbon. Still later in World War II, while in Europe, Colonel Fisher was assigned as Chemical Officer of General Patton's Third Army.

Colonel Fisher had been active in civic affairs. A Mason, he served in 1940 as Worshipful Master, Sojourners' Lodge Number 51, AF & AM, Washington, D. C.

Colonel Fisher was born in Camden, N. J. and later made his home in Cape May, N. J., and Florida. He is survived by his wife; two sisters, Mrs. Russell H. Nulty, Washington, D. C., and Mrs. Walter C. Wright of Cape May, N. J., and three daughters, Mrs. David D. Hulsey, Jr., Fort Myers, Fla.; Mrs. I. J. Turon, Glen Burnie, Md.; and Mrs. E. M. Gershater, Arlington, Va.

Funeral services were held at Arlington National Cemetery on January 16. Honorary pallbearers were: Maj. General William M. Creasy, Chief Chemical Officer; Maj. General C. E. Loucks, USA (Ret.); Brig. General John R. Burns, Commanding General, Army Chemical Center; Col. Stewart O. Hamilton, USA (Ret.); Col. Geoffrey Marshall, USA (Ret.); Col. Frederick W. Gerhard, USA (Ret.); and Col Edwin S. Bettleheim, Jr., USA (Ret.).

THE GOLD SEEKERS *(Continued from page 27)*

period the masters of the art, Agrippa, Philip Ulstadt and Oswald Croll of Germany, Edward Kelly and Thomas Vaughan of England, Athanasius Kircher, Denis Zecaire and Nicholas Flammel of France, Helvetius of Holland and a host of others compiled their treatises.

Occasionally, one of these alchemists claimed that he had prepared gold or had seen someone else carry out a transmutation. Van Helmont, a famous chemist-physician of the early 17th century, placed this report of the philosopher's stone in his writings:

I have divers times seen it, and handled it with my hands: but it was of colour, such as is in Saffron in its Powder, yet weighty, and shining like unto powdered Glass: There was once given unto me one fourth part of one Grain: But I call a Grain the six hundredth part of one Ounce: This quarter of one Grain therefore, being rouled up in Paper, I projected upon eight Ounces of Quick-silver, made hot in a Crucible: and straightway all the Quick-silver, with a certain degree of Noise, stood still from flowing, and being congealed, setled like unto a yellow Lump: But after pouring it out, the Bellows blowing, there were found eight Ounces, and a little less than eleven Grains [eight Ounces less eleven Grains] of the purest Gold: Therefore one only Grain of that Powder, had transcharged 19186 Parts of Quick-silver, equal to itself, into the best Gold.

We have the choice here of believing that van Helmont was tricked by a swindler, of which we will say more later, that he was a liar, which is improbable judging from the accounts of his life, or that he was misled by a reaction which, with his limited knowledge of chemistry, he could not interpret correctly. That the latter sometimes happened to sincere men is shown by the following directions for making gold, passed down by the Elizabethan Gabriel Plattes:

I took 8 ounces of Regulus of iron and copper, made as beneath is declared, and 16 ounces of common sublimat, bought at the apothecaries, and made the ingredients into fine powder; first severally, and then I ground them well together upon a marble stone, and so put them into a retort of glass, and drew from the first an oil, then a substance like butter, and lastly, a yellow sublimate, tincted with the tincture of iron and copper, which yellow sublimate I rectified 3 or 4 times, till it was very pure; then I mixed with equal parts of an amalgam of silver, and quicksilver, made as beneath is taught, and put it into another retort of glass, and forced away all but the silver, which remained like yellow horn: this yellow silver, I amalgamed again with new quicksilver, and sat it in gentle heat about a week, then in very strong heat about six hours; so that the quicksilver rose up, and fell down again upon the Silver, till it had carried up all from the botton of the glass in branches like trees, then I melted the silver fined it, and parted it with aquafortis. I had divers grains of pure gold abiding all trials, but the quantity would not pay half the charges.

If we follow Plattes' directions we obtain a small amount of substance which is insoluble in aqua fortis. This substance we know today is silver chloride; but Plattes had no way of knowing its true composition and he assumed that the insolubility of the residue in aqua fortis proved that the substance was gold.

Other alchemical authors, writing with tongue-in-cheek, or perhaps deliberately aiming for sensationalism to give their publisher a good seller, or even striving to express a mystical vision, claimed to know the secret of transmutation; but they wrote in such an utterly incomprehensible mann[er] that we are lost in a maze of words. One such auth[or] was an unidentified alchemist who called himself Eyr[enaeus] Philaletha Cosmopolita (supposed by some to be the American George Starkey) who, in 1669, wrote a small treatise entitled *Secrets Reveal'd: or, an Open Entranc[e] to the Shut-Palace of the King. Containing the Great[est] Treasure in Chymistry, never yet so plainly Discover[ed]*. The following selection is from Chapter 7 of *Secrets Re[veal]'d*, "Of the first operation of the preparation of the Sophick Mercury, by the Flying Eagles":

Brother, You are to know, that our exact knowledge of the Eagles of the Philosophers, is conceived and judged to be the first degree of perfection; for to know it, there is required a quick ingenuity. For do not believe that this Science comes to any of us by chance or a casual imagination, as the common ignorant people do stupidly believe; but we have sweated much and a long time, we have passed many nights without sleep, we have undergone much labour and sweat, that we might obtain the truth; and therefore, O Studious Beginner! Know of certainty, without labour and sweat thou wilt accomplish nothing (viz.) in the first Work, although in the second, Nature alone performs the Work without any imposition of hands, only using a moderate external Fire. Understand therefore (Brother) the sayings of the Sophi, when they write, That their Eagles are to be brought to devour the Lion; the which Eagles, how much the sparinger the number is, so much the greater wrestling and a slow victory, but the work is most excellently perfected in the seventh or ninth number. The Mercury Sophical, namely, is the Bird of Hermes, which is sometimes called a Goose, sometimes a Pheasant; one while this thing another while that; but wherever the Magi speak of their Eagles, they speak in the plural number, and they assign their number from three to ten: yet they are not to be understood thus as if they would have so many weights or parts of the water to one of the earth, but you must interpret their sayings to be meant of the intrinsecal weight, that is to say, you must take the water so oftentimes acuated or sharpened, as they number Eagles; which acuation is made by sublimation, and therefore every sublimation of the Mercury of Philosophers let by one Eagle, and the seventh will so exalt the Mercury, that it will become a most convenient Bath for they King.

A large number, perhaps several thousand, books were written on alchemy and the majority were as non-sensical as *Secrets Reveal'd*. Yet, in this morass of words much information was utilizable by the early chemists. Here was published for the first time methods of preparing new compounds, as tartaric acid, glauber's salt, and prussian blue; the procedure for isolating a new element, phosphorus; and useful reactions, such as the gallic acid test for iron.

Paracelsus

The year after Columbus discovered America there was born in Switzerland a boy who was destined to have considerable influence on alchemy. He is known to chemists, physicians and mystics as Paracelsus. Essentially a physician, Paracelsus influenced his followers into discarding the remedies of the Greeks and Romans, still used in Medieval Europe, and searching for chemical medicines.

Paracelsus was a noisy, egotistical genius with a strong individuality. His mountainous self-confidence in his own medical theories, coupled with a loud contempt for the ideas of the orthodox doctors, made him cordially hated by the rest of the profession, with the result that most biographical sketches paint him as a blackguard—the usual story is that he died drunk. His followers, on the other hand, picture him as somewhat of a saint. The truth undoubtedly lies somewhere between these two extremes.

Early in his career Paracelsus began to use opium and inorganic materials as medicines. He advertised his successes loudly, conveniently forgetting his failures, and quickly built a reputation as a wonder-working physician. He became professor of medicine at Basle and attracted many students. Paracelsus did little to advance medicine or science, but his followers, known to history as the iatrochemists, in their search for new medicines contributed much information to the expanding body of chemical knowledge. Stannic chloride, for example was first prepared by the chemist-physician Andreas Libavius and called in his honor *Liquor fumans Libavii*—the fuming liquor of Libavius. The iatrochemists did not cease the

search for the secret of transmutation, but they devoted much of their time to medical chemistry. Through the influence of Paracelsus, chemistry became an indispensable branch of medical education.

The Alchemical Confidence Men

The belief that gold could be made from other metals encouraged the appearance of confidence men who sold gullible people recipes for making the precious metal or who talked wealthy men into financing long research projects. Evidently these swindlers appeared at a very early date, if we may judge by laws which were enacted to protect the public, for in 175 B.C. the Chinese government forbade the counterfeiting of gold by alchemical methods. In 1403-4 a statute was enacted in England which made the multiplying of gold or silver a felony, punishable by death and forfeiture of goods.

In literary productions, a mirror of their times, we may find accounts of the fraudulent alchemists. Geoffrey Chaucer (ca 1340-1400) the author of the *Canterbury Tales* in his "Canon's Yeoman's Tale" tells the story of a clever swindler who "bitrayed folkes many a tyme" into believing that he possessed a magic powder which turned mercury into silver, and who sold the recipe for a goodly sum. Two centuries later Ben Johnson satirized the fake alchemist and his victim in the comedy, *The Alchemist*, first acted in London in 1610.

The techniques used by the false alchemists to fool their victims involved sleight of hand and simple but ingenious tricks. Let us look through the eyes of Chaucer upon a confidence man ready to harvest his wealthy, interested victim. In a crucible the faker places some mercury and then, with a flourish, a bit of magic powder. He shoves the crucible into a charcoal furnace and, after it becomes hot, stirs it with a rod which has been hollowed at the tip to contain some silver filings and then covered with wax. The wax melts, allowing the silver to mix with the mercury. The mercury finally boils away, leaving behind a button of silver to delight the onlooker and lead him to open his purse to pay for the recipe for the magic powder. Or perhaps instead of the hollow rod the faker places on the lip of the crucible a piece of charcoal, hollowed and filled with silver and then plugged with wax. In the intense heat the mercury finally volatilizes while the silver melts and runs down into the crucible. Crude as these tricks were, they convinced people who were susceptible to get-rich-quick schemes. The most famous dupe in Europe was Emperor Rudolph II (1576-1612) King of Hungary and Bohemia, who placed a large number of alchemists on his payroll. At one time there were so many of his gold-making retainers in Prague that the street whereon they lived came to be known as Golden Alley.

The alchemical confidence men were curious, interesting people but they had no effect on the development of alchemy other than to place the art under a cloud and bring suspicion on the honest, sincere alchemists.

Alchemy in America

The word alchemy brings to mind the image of a mysterious, bearded, medieval European stooping over a book or furnace in a cobwebby subterranean room. Although it is not generally known, America itself has produced a few followers of the art. The most famous of these was George Starkey (sometimes known as Stirk), who was born in Bermuda, educated at Harvard (A.B., 1646) and later became a physician in England. Starkey claimed that he first learned alchemy from a wandering alchemist whom he met in Boston. Starkey wrote a small book, *Pyrotechny Asserted and Illustrated*, published in London in 1658, in which he claimed he had discovered the philosopher's stone. Another book attributed to him, *Secrets Reveal'd*, has already been mentioned. He was well-known in London as a physician and finally fell victim to a plague.

John Winthrop, Jr., Governor of Connecticut, had a reputation as an alchemist. There is an old tradition that whenever he needed gold he would retire to the forest atop a mountain called the Governor's Ring and there with the assistance of a servant make rings of the metal. Some of Winthrop's alchemical books are still in existence.

Gershom Bulkley, who graduated from Harvard in 1655, dabbled in alchemy. Benjamin Franklin, writing to Ezra Stiles, President of Yale, mentioned the presence of alchemists in Philadelphia. Gulian Verplanck, Congressman, professor and lawyer, in his works left an account of an alchemist named Jan Max Lichenstein who lived in Wall Street, New York, around 1800.

One of the most famous American students of alchemy was Major General Ethan Allen Hitchcock, a voracious reader who discovered his first alchemical treatise while browsing through a second-hand book store and thereafter collected a large library on the subject. He wrote several pamphlets, and finally a book, *Remarks upon Alchemy and The Alchemists, indicating a Method of discovering the true nature of hermitic philosophy* (1857) which became known internationally. Hitchcock's theory, that the alchemists sought the spiritual perfection of man rather than the preparation of gold, has had considerable interest among psychologists trying to fathom the mind of medieval man and explain the vogue for alchemy.

The Decline of Alchemy

While in every age there were men who scoffed at the possibility of transmutation, the advance of science in the 17th and 18th centuries led to a general feeling of security in the scientific method and to a widespread disbelief in the occult and the intangible. Furthermore, in the case of alchemy, scientists found they were unable to make gold, despite the claim and directions of a large number of treatises on the subject.

While skepticism and the rise of science were bringing about a gradual decline in alchemy, there was coming into existence a new kind of investigator, the chemist. It is not true, as is generally assumed, that the alchemists gradually became chemists and that chemistry in a sense is a continuation of alchemy. First, that which characterized alchemy, the belief in the transmutation of metals, was not adopted by the new chemists. Secondly, the viewpoint of the chemists was radically different from that of the alchemists. The alchemists had assumed that their predecessors had been able to transmute gold, and in their reading and experiments they were trying to rediscover the secret. They looked backward to the past, not ahead to new fields of research. The chemists, on the

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PIONEER WOMAN

By LUCY C. BURNS

Two years ago the JOURNAL *published an article on a woman's life at Dugway Proving Ground by Mrs. Jo Ann Montague, wife of an Air Force officer. She came to that Utah desert station of the Army Chemical Corps before the extensive construction work there which has now made it a reasonably comfortable place to live. The number one Dugway pioneer woman, however, is Mrs. Burns, the first and for some time the only woman residing at this post, which was established and organized early in World War II by her husband, Brig. Gen. John R. Burns. The story of Mrs. Burns' "pioneering," prepared for the* JOURNAL *by request, provides interesting human interest touches for Chemical Corps history of the time.—Ed.*

FOR THE PAST FOUR YEARS now I have been fortunate enough to have occupied successively the Number One house at Fort McClellan, Alabama, and the General's quarters at Army Chemical Center. This is my husband's third command and during these peaceful years there has been so much glamour and so much fun combined with the responsibilities and hard work that very few realize the many rugged and less glamourous phases which preceded our present life.

War clouds had already begun to gather in the Far East when, in February 1941, the evacuation of Army wives and children from the Philippine Islands was commenced. My husband, John Robert Burns, was then a major; we were stationed at Corregidor. Perhaps I should have realized then that I was destined to be a pioneer of some sort since my child and I were included amongst the very first group of dependents who sailed back to the United States. However, little did I suspect at that time of what life had in store for me—the strange places, the strange customs, yet with every moment of the pioneering to be interesting and alive. But all that was to come later. First, there were ten weary months of anxiety with a continent and the Pacific Ocean separating my husband and me, a period of tension, indeed, for me, one of apprehension that each week as it came along would bring us into war with Japan.

However, as matters turned out I was most fortunate for in October 1941 my husband was returned to the United States. His new duty assignment was to mean a big step-up for him and it made me a "pioneer woman." We took up life together again in Washington, D. C. My heart was full of gratitude over our reunion but for some time there still was no peace as he was like a madman—so frantic to get so many things done in as short a time as possible. He knew there was an enormous job of preparation still to be done, and I guess we both felt that there was so little time left in which to do it. Then came Pearl Harbor. He became so very busy that I think he hardly knew his wife and child were there—the job carried added importance and became The Thing in his life. Of course, I never knew all the facts nor do I pretend to even try to learn them now. But I do know he wanted a place where he could run tests—land, lots of land. I know he took a long trip away from home looking for it. I know he ran around Washington hand carrying papers to many, many offices to prevent them from sitting in baskets. There was a driving force in him I'd never seen before pushing him on to do something he simply had to accomplish. Suddenly the tenseness was gone, his dream was to be realized and he left in February 1942, for Utah. He had acquired the land from the Interior Department.

Mrs. Burns is the wife of Brig. General John Robert Burns, commander of the Army Chemical Center, Maryland. A native of Charleston, S. C., she attended school there at Ashley Hall and afterwards attended Hollins College, Roanoke, Virginia, where she received the degree of Bachelor of Arts. She is a member of Pi Beta Phi sorority. Married in 1927, Mrs. Burns, like most wives of Army officers of long service, has resided in many parts of the world, including Hawaii, the Philippines, and Japan as well as Army stations in this country from New England to the Far Western States. Mrs. Burns has made a hobby of officers' wives' clubs activities and organized such a club at her present station which has 200 members. She and General Burns have a daughter, two grandsons, and one granddaughter.

THE AREA WAS A vast desert 85 miles southwest of Salt Lake City. He named it Dugway Proving Ground—because this was where our earliest American pioneers had been forced to actually dig tracks to take their wagons through the passes, often lowering them with block and tackle. This was land that had been inhabited from time to time but never actually settled. Some of the old Pony Express markers were still there, and we did find arrowheads and an Indian rouge grinder in a spot that had once been an Indian camp. But for many years only a lonely sheepherder, a lone prospector, or some members of the grazing service had wandered into these parts. The nearest town was 50 miles away, Tooele, Utah. It was beautiful country in a wide, expansive way—treeless with miles of sagebrush and cacti dotting the ground and colossal, majestic stony mountains in the distance, with a canopy of the most beautiful blue skies flecked with snowy white clouds. On my first trip out to the camp we drove for the last 40 miles without seeing a human being or another vehicle. After the wartime bustle of Washington, D. C., and of the entire east coast, I was literally spellbound by the vast amount of space and great silence.

My husband, who by then was a Lieutenant Colonel, assumed his first command in what had been some C.C.C. buildings at Simpson Springs, accompanied by eight officers. The engineers, lumber, road scraper and all the paraphernalia moved in and Dugway Proving Ground soon became a reality. There was no room for me at Simpson Springs so I remained in a furnished apartment in Salt Lake City during my early months in Utah.

When I did move to Dugway Proving Ground (my

husband had been promoted to Colonel), I went into a three-room T of O house—as far as I was concerned that simply meant it was covered with black tar paper. There was one large room about thirty by twenty which was our living room as well as the CO's conference room. In that room was the only heating contrivance—a large potbellied wood and coal-devouring gadget. The soft coal produced lots of gas and every so often the lid would blow off and I was sure I was a target. There were two very small rooms—our bedroom and his office. The bedroom had a real nifty little bath on the outside wall. One of my household duties was to arise and, partially frozen, hold a lit candle under the bend of the pipe under the basin to melt the ice which formed there each night. A set of wooden slats formed the base of the shower—something I never learned to balance upon. The only time I could shower was about three in the afternoon when the sun was beaming on that side of the house. I'd steam up as much hot water as possible and leap in and out as fast as possible.

Col. Burns

WE HAD MOST OF OUR meals in the Officers' Mess, where I snagged many pairs of precious wartime hose climbing over the old-fashioned benches attached to the tables. Frequently I longed for some home cooking and attempted it on the top of my potbellied stove. I could stir up many concoctions made from a boiled chicken and some mighty fine stews. My at home clothes consisted of woolen slacks, sweaters, and slippers lined with lambs wool, but every afternoon after braving my shower I dressed for dinner. I always had the feeling that certain standards must be adhered to even though the background was not conducive.

For months I was the only female inhabitant except for three secretaries who made the trip daily from Tooele—fifty miles away. Nearly every afternoon we seemed to have a dust storm and sand poured in through all the windows and doors: about an inch would settle in the groove where the windows were supposed to slide. After trying all the usual housecleaning implements, I finally found that digging it out with a tablespoon was most efficient. Under normal circumstances I am sure such living conditions would have left me completely frustrated, but it was truly pleasant for a change to have all day to read and write letters and follow my own devices. So many of my dearest friends' husbands were already prisoners of war or deceased, so I could never forget for one single minute how truly fortunate I was to be at my husband's side and have him so thoroughly happy and engrossed in the job which was given to him.

WHILE LIVING IN Salt Lake City I had made some friends at Fort Douglas, Utah, one of whom was the wife of the Post Engineer. The word had passed about my mansion and one day she and her husband drove out for a visit. She was simply horrified at the quarters we were furnished for a colonel's commutation. (When I was the wife of a lieutenant, I must confess I thought that if the time ever arrived when I became the Colonel's lady that I would be sitting on my front porch in a rocking chair with simply sumptuous quarters.) My friend had rather the same idea and went to work on her poor engineer husband immediately. By then summer had arrived and we dripped through the days at 123° but slept under blankets every night.

One very hot July day a man came out to talk over rebuilding our house. We literally battled for hours because it was his plan to give me a shotgun house—one room behind the other in a straight line. I'd had that years before at Fort Benning and would have no part of it. I can still see that poor man so red in the face and the perspiration dripping and leaving yellow stains on his collar as we argued and argued. We finally compromised and I won about ninety per cent of what could be done. The rebuilt quarters are still the home of the Commanding Officer of Dugway Proving Ground. It is not an ideal home, but those who have followed us will never know how superior it is compared to what might have been if I hadn't been born with a square chin. We thought it very grand when completed and were very happy. My final battle was to take the material meant for a side road to the house and persuade them to lay it in a square for a patio. The evenings spent there were heavenly watching the bluest blue skies change to an artist's dream sunset and then settle slowly to a canopy of stars.

When the house was completed we worked diligently on the yard and outdoors. Some very kind soldiers cut some squares of turf and trucked it in from where grass grew. I had a 9 x 12 patch of lawn which grew. Everyone who was homesick for such things came to look and admire it. I am sure they thought I was slightly coo-coo

Trees planted in the desert sand provided with wooden watering troughs.

View of the Dugway area showing the CCC Camp at Simpson Springs before Dugway was established.

First New Year's Day reception, January, 1943, featuring a silver tea service and white tablecloth.

when caught cutting the grass with a pair of big kitchen shears. But while performing this operation I listened to many G.I.'s problems and troubles so much that I began to wonder whether I was a chaplain or Dorthy Dix. In those early days a priest came from Tooele, Utah, to conduct Roman Catholic services. There were no Protestant services and when I told this sad story to Dean Gibson of the Episcopal Cathedral, he himself came out every Wednesday evening for services until we later obtained a chapel and a chaplain. The green grass was an inspiration to plant roses and tomatoes. Both were successful and our rancher friend, Dan Orr, shook his head and said, "Never seen them in the desert before!" So something new was added.

WE IMPORTED HUNDREDS of trees to line the roads. They were the saddest, spindliest little things; each looked like a stick about a yard long. In order to water the roots the men built wooden troughs which they sunk beside each tree. They grew fast, and so many people helped in watering with buckets! Each evening on our regular walk my husband and I pulled all the suckers that appeared where they shouldn't be. Later when Dugway was in moth balls I almost wept when I heard our beautiful and hard fought-for trees had been jerked up and taken to Deseret.* There was one special one the G.I.'s had brought from a canyon for my yard which had more branches than any tree I'd seen in Utah. I had always intended to go back someday and put a brass plaque on it in memory of our happy days there.

In those earliest days most of the buildings were heated with the same potbellied stoves which were fired day and night. So the great terror was fear of fires. My husband was a self-appointed Fire Marshal and often on our evening walks would leap from my side into a nearby building. He would have seen sparks flying from a chimney so would personally run in to teach some greenhorn like me how to fire the darn thing. I never did learn, so sympathized with the other dumb ones.

As on every Post, as soon as the men arrive the pets appear too. There were dogs galore that had puppies and all answered mess call. We tried to keep one of the puppies in our house but he much preferred the barracks and G.I. rations. A motherless fawn was brought in and immediately became "Bambi," beloved by all. After the battle of bottle feeding Bambi, they tried to give her to a goat who had lost her baby but poor Bambi was butted about twenty-five feet and had to go back on the bottle.

The most famous of the pets and the very first one adopted was Edgar Allan Crow—a black crow with an outstanding personality. He lived with the first group of officers, tore up their papers and magazines when he was angry, stole all the shiny trinkets he could find, dipped into their pockets for coins and was constantly clowning. Edgar first saw skirts when I arrived and he didn't like them. The first time he saw me walking beside my husband he flew madly at me from the rear and took a big nip out of my back. He never had any affection for women and let us know that Dugway was a man's world and that he preferred khaki. When the first plane flew in, Edgar almost had a fit and flew out squawking trying to chase it away. He finally perched on a weathervane which spun around with him, making him angrier and angrier. Aeroplanes and women were always taboo as far as Edgar Allan Crow was concerned.

MY BIG ATTEMPT AT social success was to try to give a New Year's Day CO's reception as was customary in the Army. I had taken my silver service and embroidered linens, which no one yet had seen displayed in the desert. The cooks in the Officers' Mess baked hams and turkeys for me. There was a huge contraption of an oven that resembled an upright deepfreeze which completely baffled me, but I wanted homemade rolls. So my husband and the surgeon came to my rescue—they understood the contraption (thanks to Cooks and Bakers School) and we baked rolls until 2 a.m. The party was a huge success but what they loved most of all was the tablecloth and silver. Many had not seen a tablecloth (except the card table variety) for almost a year.

My next attempt socially was to try to do something for the scads of lieutenants. In those years of the war everyone seemed bent on entertaining the enlisted men and the bachelor lieutenants seemed to me to be the forgotten men. We enticed the sorority girls from the University of Utah to come out for a dance. They were transported by Army bus and all was well until it was time for them to return. A terrific storm accompanied by ice and snow blew in, and it would have been sheer folly for anyone to try to travel 85 miles in it. We had solemnly promised the parents that we would personally chaperone each girl on this junket, so when the dance was over we herded them into our quarters where each was forced to telephone home and explain the problem. In the meantime, two wards in the hospital were prepared to receive our healthy guests. I've never talked to so many parents or promised so many things in all the rest of my life. And I never gave another party for all the poor lieutenants.

My first female companions arrived when a company of Wacs moved in. They were a fine group of girls—one of the first companies activated during the war—and they not only added to the glamour but they worked like Trojans and did a splendid job. Almost every girl in that company had a husband or a sweetheart overseas in

Pet crow turning the spigot under the water tank to help himself to a drink.

* Another military post in Utah.

combat and they contributed all they had to help win and end the war. With them came a beauty shop which boosted my morale no end. The poor Wac who operated it wanted to drive a dump truck—she had previously been a beauty parlor operator—so she was the only unhappy one.

LATER THERE WERE new frame buildings constructed all over the place. Finally about 30 of the more courageous wives moved out to the desert to live with their husbands. For various reasons many settled in Tooele or in Salt Lake City and remained weekend wives. We all had plenty of time as there was little housekeeping to be done in our type of quarters and practically no cooking facilities so the Officers' Mess became co-ed and we had to find things to keep the girls busy. We organized a Red Cross unit that poured out almost the entire quota of sewing and bandages for the Tooele chapter. They all brought their children of all ages and met in our house. With the noise, bedlam, door slamming I often wonder how we accomplished so much but we received lots of pins and commendations. Our refreshments were ice cream cones from the Post Exchange. Later they built a larger and nicer club. By that time the club had a little money, which they turned over to the ladies for decoration. Never have I seen such careful shopping and so much diligent labor cheerfully expended. The officers' wives living there made all the draperies, painted furniture, draped dressing tables and simply loved it. The night before our grand opening the husbands washed the windows, did the spit and polish, and up went the decorations. I have heard that the present club at Dugway is out of this world but I am sure that there can be no more pride in it nor no more love for it than our group of Pioneers had in our first new one.

Back in those weary difficult days there was only one Regular Army officer at this post. Every other officer and wife, except in the case of the Executive—a former Regular Army non-commissioned officer—was brand new to the Army and the Army's way of life. In spite of this fact they took it on the chin; they took hard living and a way of life to which they were not accustomed. We've never known a better group, a more diligent group or a more delightful group. It was like a fraternity, as if you'd asked each one to join. Through adverses people drew closer to one another; certainly there were hardships to face in those days at Dugway. No matter where we have been, no matter where we have gone, no matter how luxurious life has been upon occasions since Dugway, we constantly meet and greet some of the familiar faces—who now have risen far above the stations of life they once had there—but there is not a single one who doesn't say, "Wasn't that living?"—"Wasn't that the good part of our lives?"

One of the greatest contributing factors to our morale was the steady stream of interesting and important visitors. Although most of the official activities were top secret as far as the wives were concerned, we surmised the importance of the work being done by our husbands' attitudes and were convinced of it by the many Very Important Persons who came for visits. We had all the generals of the Chemical Corps, of whom there were many during those days, plus many from other branches. We had groups of British and Canadian officers regularly and the top ranking members of the National Defense Research Committee. It was a time when I would have enjoyed having had the most luxurious quarters and our best equipment as a hostess. But our guests did not mind and we thought less of material things during those days. Never have I enjoyed more scintillating and inspiring conversations than we had during those visits. Never will I forget the many fine serious faces we gazed upon amongst those officers and those civilians who were all so seriously using all their talents and energy to end that awful war.

MANY OF THESE VISITORS became our house guests for a few days. By that time I had acquired a young soldier's bride as a part-time worker. She was a novice to that type of work as well as to the Army. When she left one afternoon I informed her we would be having two generals for breakfast. The next morning she appeared in a red velvet cocktail dress, flowers in her hair and dangling earrings. I had a dreadful time keeping her in the kitchen, and I'm sure she forever considered me a dope for trotting around amidst such prestige in my little morning cotton.

My very best helper was my husband's driver, who always offered to assist when he saw help was needed. He was a fixture and one of Dugway's most lovable characters. Before I actually moved out to live in the desert I'd made a visit to my husband's quarters for several days. I innocently hung my laundry on a line in back of the quarters, forgetting at that time that Dugway was a male's Paradise. After lunch the driver rushed in, red with embarrassment, to ask me to please remove my laundry indoors as some of the men in the mess were talking about the C.O. having a woman in his quarters—they'd seen her laundry! Whenever that boy went on leave he always sent us cards beginning, "Dear Folks"—we still hear from him today as we do from many others.

I knew there'd be a time when my husband felt his part of the job was accomplished as he had indicated upon occasions. I dreaded that day's coming but I knew the man. Inside of him there was another thing that must be accomplished. He personally must help end the war in the Pacific where we had lost so many friends. He had helped prepare for it on Corregidor and at Dugway but he wanted more. When the offer came for him to join the Sixth Army on Leyte I knew the answer would be, "Yes." As much as he loved Dugway and its inhabitants, he was actually jubilant. On November 27, 1944, I hid my tears long enough to accompany him to San Francisco and try to wave good-bye with a weak smile as he drove off in a Government carryall to take the plane which would land him in Leyte.

I RETURNED TO THE Hotel Utah to cry silently for three day between packing my child out of Rowland Hall and bidding farewell to so many dear friends. His new home was to be a foxhole—mine a comfortable house on the east coast. Reluctantly I turned my heart and mind on Dugway—it was a sad farewell and parting—but I was gladdened by the thought, shared by so many of us there, that 'Someday Dugway will be famous;' we were fortunate to have been the 'Pioneers'."

HONORS FOR DR. GIBSON

Two new honors have recently come to Dr. R. E. Gibson, Director of Applied Physics Laboratory of Johns Hopkins University and first vice president of A.F.C.A. Dr. Gibson has been made president of the Cosmos Club of Washington, D. C. and also president of the Washington Academy of Science.

NEW MEDICAL LAB CHIEF

Colonel Albert R. Dreisbach, 50, formerly commanding officer of the United States Army Hospital at Fort Leonard Wood, Missouri, has been named commanding officer of the Medical Laboratories at Army Chemical Center, Maryland. Colonel Dreisbach was graduated from the University of Pennsylvania Medical School in 1931. He succeeds Colonel Norman W. Elton, who has been assigned to duty at Governors Island, New York.

THE GOLD SEEKERS *(Continued from page 39)*

other hand, cared nothing for the past but only for what lay ahead. They were eager to discover the nature and properties of the materials which made up the globe, the way in which substances reacted, and the reasons for the empirical operations of chemical arts. Finally, the new science drew its information not from alchemy alone but from many technical arts, as tanning, mining, metallurgy, glass making, pottery, pharmacy, pyrotechnics, dying, bleaching, brewing and perfumery. Alchemy provided many facts, but its almost unique contribution was laboratory technique, the method of dealing with small quantities of materials in specially designed apparatus.

The chemists evolved gradually, beginning in the late 1500's. By 1677 such progress had been made that a book with a modern sounding title, *Course of Chymistry*, appeared. This text, by Nicholas Lemery, dealt almost exclusively with the practical side of chemistry, there being little that could be said at that time on theory. Lemery classified materials as mineral, animal and vegetable, a division which was retained into the early 19th century. By 1732 the objective of the chemist had become so clearly defined that Hermann Boerhaave expressed it in his *Elements of Chemistry* as an "art which teaches the manner of performing certain physical operations and also seeks to investigate their causes." In the middle third of the 18th century early chemistry accelerated rapidly, culminating in the "Chemical Revolution" of Priestley and Lavoisier, at about the time of the American Revolution.

But while the long tradition of alchemy came to an end in the 18th century, the lure of gold making continues to attract men. From time to time some person, perhaps believing that the alchemists succeeded, tries to follow in their footsteps. Toward the end of the 19th century an alchemical journal was published in France. In the United States the Rosicrucians, organized shortly before the start of World War I, professed to believe in transmutation. Finally the author is aware of alchemical experiments, based on the writings of Paracelsus, actually carried out by two Germans in the early 1940's.

Considering what has now been made to happen in the cyclotron, who can say that the alchemists did not have a point?

REPAIR PARTS *(Continued from page 31)*

6. ***Reduction of Parts Inventory by Standarization.*** The development of standard military specifications and drawings for every item required by the Army would be the purest approach to obtaining complete uniformity in repair parts. However, it would create an unbalance of new problems of a different nature. In many instances it would be impossible and quite unnecessary to establish specifications for those items of a commercial nature. Furthermore, modifying a commercial type item to a military specification would increase its cost by the manufacturer having to set up his production line to produce low quantities of an item and making necessary adaptions to incorporate the special features indicated in the specifications. Another drawback would be that the specifications would require continual revisions to derive the benefits of improved design that the manufacturer incorporated in his regular line of merchandise.

On the other hand, there are unlimited opportunities for reduction of repair parts through the utilization of standardized procurement specifications. Some instances are, for military type items, those items for which the military is the largest user, and when commercial items are available from only a single source or a limited number of sources. Further opportunity for standardization exists where it is possible to obtain industry-wide agreement to standardize the end item or major components.

7. ***Repair Parts Kits.*** The preceding six topics were the dominating factors in determining the reclassification of each item in the Chemical Corps supply system toward accomplishing the goal of purifying the repair parts system. Upon completion of this review, the remaining items were further examined for the purpose of consolidating individual items, where feasible, into repair parts kits.

The primary approach in the final execution of the above-mentioned project consisted of segregating component parts common to an assembly, such as a carburetor, into one group and by analyzing the useful life expectancy of one item against its mating part, a resultant kit of items was developed to replace each individual item of supply. It is contended that it is more practical and economical to store and issue an assembly of individual items, at the possible expense of furnishing a part not immediately required, than to procure, store, and issue each component part separately. In all likelihood, the part that seemingly does not require replacement at that time will have expended between 60-90% of its useful life. Approximately 340 individual items were incorporated into 79 repair parts kits.

Saving of $200,000 Annually

A summary of the effects and economics of the elimination of nonessential repair parts from the supply system indicates a considerable reduction in required storage space, man-hours, stock control records, etc., and an estimated dollar value savings of $200,000.00 annually. The resultant monetary savings is of interest to every American taxpayer and the significance of repair parts in the Department of the Army operations should be continually foremost in the minds of research, development, design, and supply personnel.

THE DU PONT COMPANY

(Continued from page 23)

on the death of Henry du Pont in 1889, replied, "For the last four months we have devoted the whole output of our mills to the Bureau and Ordnance Department. Our customers who have been with us for years have been scantily supplied. We have jeopardized our business to a great extent. As to compensation, we fully believe that our business will be benefited to a much greater extent by turning our mills onto the regular manufacture than it would to continue to make Brown Prismatic powder. We, therefore, think that no compensation is required for the money expended in increasing the output of Brown Prismatic powder."

The years 1898 to 1914 were significant in the development of the Du Pont Company and in its relationships with the government. Throughout the period the company worked with the Army and Navy in development of improved types of powder, and the company gave valuable assistance in design, construction, and operation of the Navy smokeless powder plant at Indian Head, Md., and the Army's Picatinny, N. J., Arsenal.

The death of Eugene du Pont in 1902 led to reorganization of the company under the new leadership of T. Coleman du Pont, Pierre S. du Pont, and Alfred I du Pont. In the powder business for a century, the company had entered new chemical fields of chemistry, notably the chemistry of cellulose, through its interest in smokeless powder. The new management resolved that henceforth the company was to be regarded not as a producer of explosives alone, but as a chemical manufacturer ready to venture wherever its logical chemical interests might lead. This diversification of interests was to put the company in a position to make far broader contributions to national defense.

It was during this period, in 1907, that the Department of Justice brought suit against the company, charging violation of the anti-trust laws in its explosives business. In 1911 the Supreme Court handed down an interlocutory decree, directing that the government and the company work out a plan for the company's reorganization. Representatives of the Army and Navy then appeared before the court to urge that Du Pont's military smokeless powder business remain intact. In peace and war, they said, relations with the company had been satisfactory for more than a century. The government's own plants gave an effective gauge of the fairness of Du Pont's prices. Also, they said, Du Pont's plants and laboratories had always been open to the Army and Navy and the company's cooperation had saved the government large sums, usually without compensation to the company.

In its final decree, in 1912, the court directed that Du Pont be divided into three competing companies, but that the entire military smokeless powder business be retained by Du Pont. A breakup of this business, the court said, "would tend to destroy the practical and scientific cooperation now pursued between the government and the defendant company, and to impair the certainty and efficiency of the results thus obtained." The decree added, "No benefit would accrue to the public by dividing this business between several competing concerns, while injury to public interests of a grave character might and probably would result therefrom."

August 1914, brought World War I. It soon became apparent that the Allies were unprepared for trench warfare, which required huge quantities of high explosives. They turned to the United States in urgent need. Russia ordered 960,000 pounds of TNT from Du Pont on October 8. Four days later France ordered 8,000,000 pounds of cannon powder and 1,250,000 pounds of guncotton. By the end of May 1915, Du Pont powder orders exceeded 107,000,000 pounds and TNT orders, 22,000,000 pounds. The company's capacity for military smokeless powder in October 1914, was 8,400,000 pounds annually.

Smokeless powder had never been produced on such a scale. Since the United States was not in the war, and the war's duration and ultimate result were uncertain, Du Pont asked the Allied governments to finance the unprecedented expansion by covering the cost of new facilities in the price of the powder. This was acceptable to the Allies, provided the orders were filled promptly.

Construction of the first unit of the expansion was begun in October 1914, and production began in March 1915. Additional units were started and put into operation each month. The company's Engineering Department, which in 1914 had 800 men and grew to 45,000 at its wartime peak, forecast the start-up date before each ground breaking, and kept its promise in every case.

From an annual capacity of 8,400,000 pounds in October 1914, Du Pont smokeless powder plants at Carney's Point, Haskell, and Parlin, N. J., grew to a capacity of 200,000,000 pounds a year by the end of 1915, to 290,000,000 pounds a year by the end of 1916, and to 357,000,000 pounds by the time the United States entered the war in April 1917. This enormous increase would not have been possible without perfection by the company of a water-drying process, on which some experimental work had been done before the war, and which permitted powder to dry in a few days instead of weeks or even months required for air-drying. At Hopewell, Va., Du Pont in 1915 built the world's largest guncotton plant, which, before the end of the war, was to employ 28,000 persons and produce more than 1,500,000 pounds of nitrocellulose a day.

In 1916, General Hedlam, chief of the British Munitions Board, said, "The Du Pont Company is entitled to the credit of saving the British Army."

During the summer of 1917 the government entered negotiations with the company for construction of new powder plants, and a contract was signed in October, calling for two or more plants. This contract, however, was cancelled by the Secretary of War and replaced by one calling for one plant to be built and operated by Du Pont, and another by other contractors. In line with long-standing policy, Du Pont gave the government full cooperation in planning the facilities to be built and operated by the other contractors.

The contract signed with Du Pont on January 29, 1918, called for a smokeless powder plant capable of producing 900,000 pounds of powder a day, to be divided into nine units of 100,000 pounds each. It was to be the world's largest powder plant.

On February 9, construction was started on seven miles of railroad to bring materials to the plant site at Old Hickory, near Nashville, Tenn. The railroad was completed 29 days later, on March 9. Ground was broken March 8. The first sulfuric acid unit came on stream 67 days later, on June 1. Nitric acid was produced June 10, guncotton on June 23, and the first powder was granulated July 2, only 116 days after breaking ground, and 121 days ahead of the contract requirement. By November 11, when the war ended, the sixth powder line was ready for operation, and the first five lines were producing at a rate of 501,000 pounds a day. The entire project was 93 per cent completed, and had produced 36,000,000 pounds of powder—13,000,000 pounds more than required by the contract.

In all, the Du Pont Company supplied 1,466,760,000 pounds of military explosives to the United States and the Allies, an amount estimated to be 40 per cent of the total made for the United States and Allies throughout the world. The company was continually ahead of deliveries and at all times had large quantities of explosives in its magazines awaiting shipment.

The magnitude of the task went far beyond mere quantity of explosives. The sudden call of the Allies in 1914 required adaptation of American powder, then almost unknown abroad, to guns designed to use other ammunition. This required development of 40 different powders for as many guns. Each had to function under exacting specifications. As an example, some of the powders averaged 42,000 pieces to the pound, and each piece had to be a perfectly formed cylinder with longitudinal perforations whose important dimensions had to be exact within a tolerance of 1/1000 of an inch.

Besides foreign powder the company had to supply 90 different powders, all produced under strict specifications, for the United States Army and Navy. Many changes in ballistic requirements were made as the war progressed, each demanding changes of characteristics in the powder. In spite of these diverse and exacting requirements, not a single lot of Du Pont powder, I am told, failed of acceptance or was returned as unsatisfactory.

The technology that brought increased production also brought notable savings in manufacturing costs. Contracts made in 1917 and 1918 with the government for military cannon powders, the largest quantity item, were at prices 10.7 per cent lower than those prevailing before the war, despite the fact that raw materials prices during the last year of the war were 132 per cent above pre-war prices.

The company's annual report for 1918 stated: "The sudden ending of the war on November 11, 1918, brought about an almost immediate curtailment of the activities of E. I. du Pont de Nemours & Company, and the few remaining weeks of the year 1918 were sufficient to eliminate almost completely all munition business. The magnitude and rapidity of this reduction is well illustrated in the shrinkage in number of employees at munition plants, of whom on November 11th there were 85,638 engaged on war orders, while on December 27th, 28,101 only remained on the payrolls. Officers of the company encouraged the departments at Washington to cancel all contracts quickly in order to save material and labor in producing unnecessary explosives. It so happens that orders for the year 1918 were practically completed. Little will be done on contracts covering the first six months of 1919 and no profit will be derived from the uncompleted portion thereof. The contracts cancelled amount to about $260,000,000.

"The company now returns to its commercial business . . ."

The commercial business to which the company returned was destined to be far different from that of the pre-war years. Interrupted by the war, the program of diversification, which had had its beginnings in the early years of the century, now was able to move forward in high gear.

The 1920's saw Du Pont's entry into many new fields, including rayon, cellophane, tetraethyl lead, photographic film, and high-pressure synthesis of ammonia. "Duco" pyroxylin lacquers and "Duflux" synthetic resin enamels were among the developments of the period. Still more important was the establishment in 1927 of a program of fundamental research which laid the foundation for such outstanding developments of the 1930's as nylon and neoprene.

When World War II came, the company was prepared to contribute to national defense not only in its historical field of explosives, but in literally hundreds of lines demanded by total war.

A mechanized war machine required rayon and nylon tire cord, synthetic rubber to replace the loss of the natural product, petroleum additives for gasoline and fuel oil, and heavy chemicals by the thousands of tons to supply the industries producing combat equipment.

Air power called for hundreds of special chemical materials—plastic enclosures, finishes, ingredients for high-octane gasoline, tire yarn, synthetic rubber and high-tenacity rayon for self-sealing gas tanks. Nylon replaced silk for parachutes. As many as 86 chemical products from a single company plant went into the building of a superfortress.

In World War I, explosives made up approximately 85 per cent of the Du Pont effort. From December 1940 to August 1945, Du Pont produced three times the quantity of military explosives it had from 1915 to 1918. Yet military explosives accounted for less than 25 per cent of the company's total production in World War II. The fact that explosives production, although so sharply reduced in relative importance, was still several times that of the previous war affords a further measure of the increase in other materials essential to warfare.

Du Pont's capacity for military explosives before the war was negligible. For 20 years such materials had accounted for less than two per cent of sales. In January 1943, when the war explosives program reached its peak, the company was operating, in addition to its own facilities, six company-built government-owned ordnance plants, with a combined employment in military explosives operations of some 37,000 workers. In that month, the company produced 66,458,000 pounds of smokeless powder, 44,685,000 pounds of TNT, 1,707,000 pounds of tetryl, 3,557,000 pounds of RDX compositions, and large quantities of other munitions. Total explosives production from December 1940, to August 1945, was approximately 4,500,000,000 pounds, an amount 20 per cent more than the entire volume used by all Allies during World War I.

The Du Pont Engineering Department designed and built 54 plants of various sizes at 32 locations for the government. Nearly half of this construction program was devoted to meeting military explosives requirements, toward which the company contracted for the engineering, design, and construction work at eight government-owned explosives plants. The company also designed and built facilities for the Naval Powder Factory at Indian Head, Md., for increasing smokeless powder manufacturing capacity.

In addition, the company built for the government a neoprene synthetic rubber plant at Louisville, Ky.; an ammonia-methanol plant at Morgantown, W. Va.; two Chemical Warfare Service plants at Niagara Falls, N.Y., and New Martinsville, W. Va.; a Navy hydrogen peroxide plant at Dresden, N. Y., and erected on its own properties numerous special facilities financed by the Defense Plant Corporation, the Office of Scientific Research and Development, and other government agencies.

Design, procurement, and consultant services were furnished in connection with a large number of other government-financed plants, including the Rocky Mountain and Picatinny Arsenals, five TNT plants built and operated by other companies, and four plants to manufacture small arms ammunition by Remington Arms Company, a Du Pont subsidiary.

The largest single undertaking by Du Pont during World War II, however, was in an entirely new field. In the fall of 1942 Major General Leslie R. Groves, repre-

senting the War Department, asked the company to build and operate a plant for mass production of plutonium, of which less than a milligram was then in existence. He knew he was asking the company to enter a field about which little was known beyond the fundamental scientific theory, but the request was urgent; America's enemies were seeking the same end, and if they got it first, even in the last minute before collapse, the entire course of the war would be changed.

Du Pont officials were reluctant to accept the assignment because of its magnitude and because it seemed to fall outside the general field of chemistry. But General Groves insisted on the urgency of the situation. As Walter S. Carpenter, Jr., then president of the company, reported later, "we felt compelled to give up our hesitation about participating in the project, taking the position that if the government believed Du Pont's assistance was needed, we could not refuse."

Du Pont accepted with two conditions: It would do the work for a total fee of $1, and any patent rights would go to the government.

The result was the Hanford Engineer Works, built at a cost of $350,000,000 on a 600-square mile tract of sandy desert in Washington. Built without precedent, without guideposts, the plants at the Hanford Engineer Works were huge structures. They were plants in which materials in enormous quantities were handled through many successive processes with at times no human eye ever seeing what actually went on, except through a complicated series of dials and panels, that permitted the operators, in many cases behind concrete walls, to maintain proper control of every operation at all times.

As an adjunct to construction of the plant itself, it was necessary to build housing for construction workers at Hanford, a community which mushroomed to 60,000 inhabitants in the course of two years. The actual construction force reached 45,000 at its peak in June 1944. The separate village of Richland, built to house the plant operating force, had a population of 15,000.

After the war, Walter S. Carpenter, Jr., reported to stockholders: "World War II brought to the Du Pont Company the necessity of interrupting its regular activities and development to perform, like so many millions of individuals, a simple duty.

"Now, the end of the war finds Du Pont, as it does the nation, eager to resume its normal constructive role. It should be plain that the business interests of the company lie, primarily and overwhelmingly, with peace. However essential to modern warfare the chemical industry may be, its prosperity and its prospects can be realized only in a peaceful, orderly society.

"Every practical consideration, therefore, in addition to the obvious personal and humanitarian aspects, prompts the prayer that means will be found to insure world peace forever."

Once more war contracts were terminated. In 1946, Du Pont turned over operation of the Hanford Engineer Works to the General Electric Company. This was in accordance with understandings reached between Du Pont and the government at the inception of the project, and was influenced by the company's belief that a concern more directly interested in power generation and utilization should pursue the development of atomic power.

Instead of the lasting peace that men had hoped for, the immediate postwar years brought the cold war. Once more the needs of national defense were pressed on the company. At the urgent request of the Atomic Energy Commission, the Du Pont Company agreed in 1950 to undertake the design, construction, and operation of new facilities for manufacture of materials for both atomic and thermonuclear, or H-bomb weapons. As in the case of the Hanford project, this was an undertaking in a relatively new and unchartered technical field. And, as in the case of the Hanford project, Du Pont accepted the task under the conditions that the company receive a fee of one dollar for its work, and that any patents growing out of Du Pont's work should become the property of the government, not Du Pont.

As a result of this agreement, Du Pont designed, built, and is now operating the Savannah River plant, one of the largest industrial projects ever attempted. The plant was built on a site of 200,000 acres, about 315 square miles, southeast of Augusta, Ga. It has an electric power system comparable to the State of Delaware, and a water consumption approximating that of Philadelphia.

It is estimated that 120 different skills and talents were combined in one technological effort to achieve the final design. All of Du Pont's laboratories were called on for scientific talent, and management, supervision, and operating personnel were drawn from across the company boards. Professional consultants were called on in specific fields. In short, the task relied on every resource and benefited from every policy established during Du Pont's background of more than a century and a half of industrial growth.

Construction activity started early in 1951 and increased steadily until the construction force reached a peak of 38,500 employees in September 1952. While construction was carried out by the company's Engineering Department, thousands of business concerns, large and small, contributed to the success of the project. More than 138,000 orders and contracts were placed with other firms for materials, equipment and services costing more than $500,000,000. More than 87,000 orders, representing almost $245,000,000, were awarded to firms having fewer than 500 employees.

The Savannah River project, built at a cost of well over $1,000,000,000, is in production today, with an operating force of about 8,000 employees.

Du Pont also operates for the government the Dana atomic energy facilities at Newport, Ind., and the Indiana Ordnance Works, first and largest of the smokeless powder plants built by the company for the government in World War II.

While post-war sales of products from the company's own plants for defense end use have been small in relation to total sales, they nevertheless have been sizable, and virtually every department of the company is cooperating with the armed services in application of products for military use.

The ability of the Du Pont Company, like that of the chemical industry as a whole, to meet the defense needs of the nation in times of emergency is largely dependent upon the strides it has made in times of peace. Its contribution will be the productive capacity brought into being during the peaceful years plus the technical ability to adapt its products and ideas to military requirements. In this respect, the company is in a much stronger position to meet defense needs than it was in 1940. Its production capacity for essential chemicals and chemical products has been greatly expanded, important new products have resulted from the company's research, and the company's reservoir of technical talent and know-how has grown. Without minimizing the important contributions made by business units of lesser size, it is, I believe, fair to say that the history of the Du Pont Company in national defense demonstrates well the heavy dependence of the nation on enterprises capable of undertaking tasks which inherently require large resources, both technical and financial.

NEW CHEMICAL CORPS POSITIONS

—U. S. Army Photos

Pursuant to recommendations of the Miller Committee,* approved by Secretary of the Army Brucker, the Chemical Corps has been undergoing reorganization and a number of new positions have already been announced. These are:

Asst. Chief for Planning & Doctrine

Brig. General William R. Currie has been appointed to this post, one on which the Miller Committee placed particular stress. Specific duties assigned to General Currie's office include studies looking ahead for the proper places of chemical, biological and radiological warfare in military planning; preparation and maintenance of exhaustive documents on all phases of chemical, biological and radiological warfare and weapons systems; active liaison with other branches of the Army, the Navy and Air Force, and other government agencies.

General Currie, promoted to his present grade last July, is a graduate of West Point, class of 1928. He attended the University of Chicago from 1946 to 1948, doing graduate work in physics and mathematics.

He has the following decorations: Legion of Merit; Commander of the Star of Africa (Liberia); Order of the British Empire; and the Croix de Guerre, with palm (1942) (Belgium).

Executive Director of the Chemical Corps

Mr. Edgar A. Crumb has been appointed to a newly created position with the title of Executive Director of the Army Chemical Corps. In this capacity he becomes a member of the Corps' top management team as one of the Chief Chemical Officer's principal assistants.

Mr. Crumb has been connected with the Chemical Corps since 1939. His most recent position prior to joining the headquarters management staff was that of executive director of the Chemical Corps Research and Engineering Command.

He was born July 5, 1916, in Northampton County, Virginia, and attended the New Mexico School of Mines. During World War II he saw active duty as a Marine Corps officer, and now holds the rank of Lieutenant Colonel in the Army Reserve.

Mr. Crumb is a graduate of the Industrial College of the Armed Forces, he is a charter member of A.F.C.A., a member of the American Society of Mechanical Engineers, the American Chemical Society, and the American Association for the Advancement of Science.

* An ad hoc committee headed by Mr. Otto N. Miller, vice president of the standard Oil Company of California, appointed by General Creasy to study and make recommendations on the Chemical Corps organization. A report of the recommendations was made in the September-October 1955 issue of the Journal.

Chemical Corps Engineering Command

Colonel William J. Allen, formerly head of the Engineering Agency at the Army Chemical Center, has now been made Commanding Officer of the new Engineering Command of the Corps, with headquarters at the Center.

The new command will be responsible for assuring that newly developed items are suitable for mass production methods, and that such items will require the least possible amount of critical materials. It will provide centralized engineering services to other agencies of the Chemical Corps and will carry out the Corps' responsibility in connection with new construction and major alterations of facilities in collaboration with the Corps of Engineers.

The Miller Committee said that consolidation of all engineering into one organization would make available stronger specialized talents on all engineering problems.

Materiel Command to Move to A.C.C.

Brig. General Marshall Stubbs, heads the Chemical Corps Materiel Command which is slated to move its headquarters from its present location at 200 West Baltimore Street, Baltimore, Maryland to the Army Chemical Center, near Edgewood, Maryland. The move will affect 98 military personnel and 345 civilians. It is scheduled to be completed by April 1, 1956. A survey conducted in May of 1955 indicated that should a relocation to Edgewood take place, 90% of the key personnel would follow.

The Materiel Command is responsible for procuring, supplying, storing and issuing items of Chemical Corps equipment for the Army, Navy, and Air Force. General Stubbs has been its Commander since January 1954.

Career Management Division

Colonel Frank M. Arthur, formerly Chief of the Plans, Training and Intelligence Division, has been made Chief of the newly created Career Management Division.

This new division encompasses the Civilian and Military Personnel Branches of the Administration Division, and certain functions of the Training Branch of the former Plans, Training and Intelligence Division.

Colonel Arthur served as Chemical Officer with the 41st Infantry Division and later of the I Corps in the Far East during World War II. He has been awarded the Distinguished Unit Badge, the Bronze Star Medal and Oak Leaf Cluster, and the Army Commendation Ribbon. He also received the Philippine Presidential Unit citation in 1950. Col. Arthur is a graduate of the Chemical Corps School, the Command and General Staff College, and has a Masters degree in Business Administration from George Washington University. He is a member of Phi Beta Kappa and Alpha Kappa Psi.